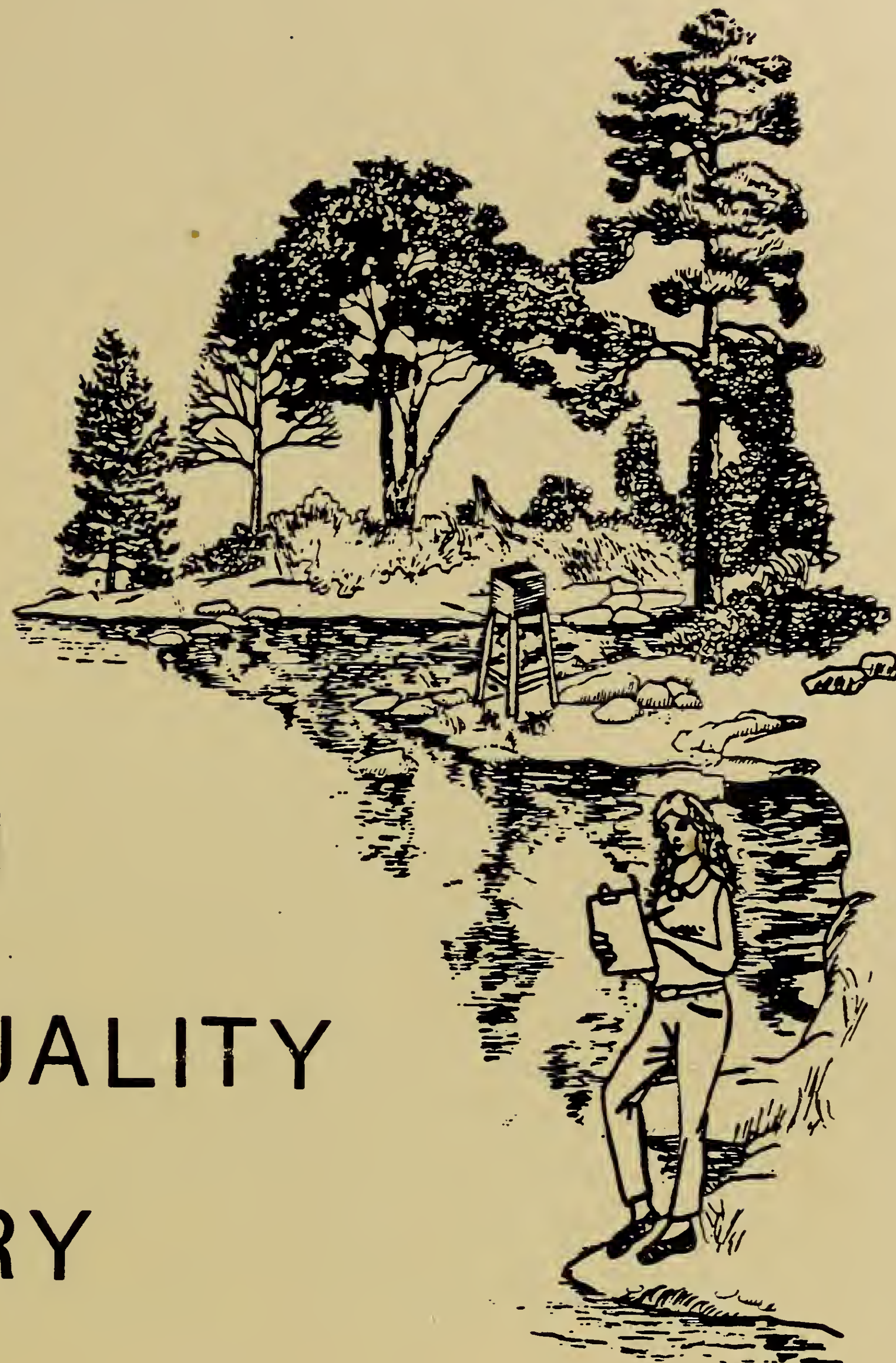

1980/81 WATER QUALITY SUMMARY

Soil Conservation Service

United States
Department of
Agriculture

National Agricultural Library

1980/81 WATER QUALITY SUMMARY

SOIL CONSERVATION SERVICE

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TRANSMITTAL

The following document summarizes the Soil Conservation Service's investigations and activities in water quality for 1980/81. This fulfills a requirement of SCS Environment Memorandum-16 to summarize measured impacts of specific SCS activities on water quality compared to projected impacts.

Water quality is a multidisciplinary subject, and in the Soil Conservation Service, it is addressed by several programmatic and technical staffs. This year we decided to upgrade previous efforts to present a more comprehensive Water Quality Summary than in past years. The Summary, in addition to the usual technical statistics on water quality, examines the present status of water quality in SCS, including the objectives and operations of several programmatic and technical SCS staffs.

Some of the Summary highlights are descriptions of water quality activities in SCS programs, coordination of water quality activities at the National Headquarters and Technical Centers, statistics on water quality investigations, "success" stories showing where water quality has improved through SCS efforts, and a listing of SCS water quality contacts at the National Headquarters and around the country.

The combined effort of many SCS people has made this Water Quality Summary a reality. While the document, with its technical and other materials, is aimed at SCS State Office personnel, the information may be useful at the Area or District Conservationist level. We seek your responses to the Summary and hope it will be useful in SCS daily activities.

FOREWORD

What does my job have to do with water quality? The question keeps arising. Concern for water quality has always been with us. It is not a creation of the environmental 70's. Its roots go back to the last century with concerns for public health. However, SCS's leadership role in water quality is relatively new.

Water quality means many things to many people, but seldom is the term well-defined. Water, and especially good water, is taken for granted perhaps because water is so abundant on our planet. However, to maintain a proper living standard it is not enough just to have water, it must be water of the highest quality.

Agriculture depends on excellent water quality for its productivity more than any other single element. Crop irrigation requires high quality water to nourish and sustain plants. All processed crops require abundant supplies of pure water for washing and cooking. Animal waste systems depend on water to flush away wastes and then recycle the water for efficient operations. Livestock need disease-free, drinkable, and readily available water. Farm wildlife also need water for their growth and reproduction. Good water quality aims at keeping water free from harmful nutrients, pesticides, sediments or other constituents which may degrade the water.

Soil protection and water quality improvement are two sides of the same coin. We can not spend one side without spending the other. For nearly the last 50 years SCS has concentrated on placing conservation practices on the land, while attention to water quality problems has been a secondary concern. In recent years SCS has realized it must work on water quality aspects as well as soil erosion aspects.

What does my job have to do with water quality? The answer employees are finding is that they are more involved with water quality than they ever imagined. Throughout SCS water quality awareness is growing, training is expanding, committees are working on water quality problems, and individuals are incorporating water quality decisions into their daily tasks. The challenge to SCS today is to efficiently blend the dual goals of soil conservation and water quality management. The task is not easy, but many employees are seeing they must treat the entire natural resource base of the soil and the water associated with it.

Photo: USDA-SCS

Excellent water quality depends on appropriate soil and water conservation practices being applied in urban and agricultural areas.

II WATER QUALITY PROGRAMS

WATER QUALITY IN SCS's PROGRAMS

For many years in Soil Conservation Service programs, while water quality has not been necessarily a major objective, all SCS programs have had a definite impact on water quality. SCS personnel have conducted their assigned duties and tasks, accomplishing their main soil conservation objectives efficiently and effectively with secondary benefits in the area of water quality.

Water quality has been a national concern for many years, as evidenced by the passage of the Federal Water Pollution Control Act Amendments of 1972 and the Clean Water Act of 1977. The National Environmental Policy Act of 1969 mandates that in significant Federal actions important environmental concerns be addressed. This includes water quality. Thus SCS has become more involved in water quality issues with each passing year. SCS's responsibilities in the water quality area include the preparation of Environmental Impact Statements, and activities responding to sections of the above water quality acts, such as 208 (non-point source control) and 404 (dredge and fill discharge control).

Programs, like Watersheds, have helped to highlight the need for water quality monitoring. In selected projects this has been accomplished. In other programs water quality needs have not been as clearly addressed. Nevertheless, water quality needs are ever present, and with the importance of water quality and quantity looming larger and broader in our daily lives, we must continue to place even more emphasis on water quality.

We asked each SCS program office with duties affecting water quality to summarize activities in their programs concerning water quality. The initial response from several program offices was that water quality played a minor role in their program, and generally was considered secondarily in the general program planning. Other more pressing issues took precedent. However, after the individuals focused on the potential of water quality to influence their programs, they began to recognize that water quality did indeed play an important, if not significant part in their program tasks.

The following are short descriptions of SCS programs and their involvement with water quality issues and aspects. In most cases recognition of water quality problems has been cited, and several programs have actively integrated water quality activities into their daily routines.

We thank the following people for contributing by writing the following material. These program descriptions add immeasurably to understanding the water quality activities in SCS.

Kenneth R. Voss--Project Development and Maintenance (Watersheds)

Francis T. Holt--Project Development and Maintenance (Resource Conservation and Development)

Horace J. Austin--Basin and Area Planning

George Stem--Water Quality Project Implementation Program

James B. Newman--Land Treatment Programs

Howard C. Stevermer--Conservation Planning and Application

Photos: U.S. Fish & Wildlife Service

The quality of water can be influenced by restricting or releasing water from urban and agricultural areas.

RURAL CLEAN WATER PROGRAM

An outgrowth of the Water Pollution Control Act Amendments of 1972, (P. L. 92-500) was the development of point and non-point source water quality management plans for pollution control. With extensive inputs and assistance of conservation districts, SCS and other USDA agencies, rural agricultural non-point source control water quality management plans were developed for each State and approximately 50 designated metropolitan areas across the country. The water quality management plans, eventually approved by the State governors and U.S. Environmental Protection Agency, identified water quality problems, sources of pollutants, alternative treatment needs or Best Management Practices (BMPs), and designated management agencies for implementation of agricultural non-point source control plans.

These water quality management plans recognized the problems of erosion, drainage, leaching, and animal waste disposal in agricultural operations as one of the largest single sources of water pollution. In order to achieve the "fishable" and "swimmable" water objectives of the Clean

Water Act, proper management and control programs were needed to prevent further contamination of streams, rivers, lakes, and the Nation's precious water resources.

To combat this threat, the experimental Rural Clean Water Program (RCWP) was enacted by Congress in 1979 with $50 million appropriated in fiscal year 1980, and $20 million in FY 1981. The voluntary program provides long-term financial and technical assistance to owners and operators of privately held agricultural land in selected project areas who install and maintain Best Management Practices to control water pollution. Participants must have an approved water quality plan, and their activities must contribute to critical water quality problems in the area. Indian tribal lands and lands owned by irrigation districts are also eligible.

The RCWP is designed to build on experience gained from the Agricultural Conservation Program (ACP) and other existing programs, but is limited to areas having significant agriculture-related water quality problems.

Best Management Practices for which a participant may qualify for cost-sharing, are those that reduce the amount of pollutants entering a stream or lake or contain them at the source. These BMPs assist in improving water quality, reducing costs to cities for water purification, preventing fish loss, enhancing the environment and providing new and improved recreation areas for water-based sports.

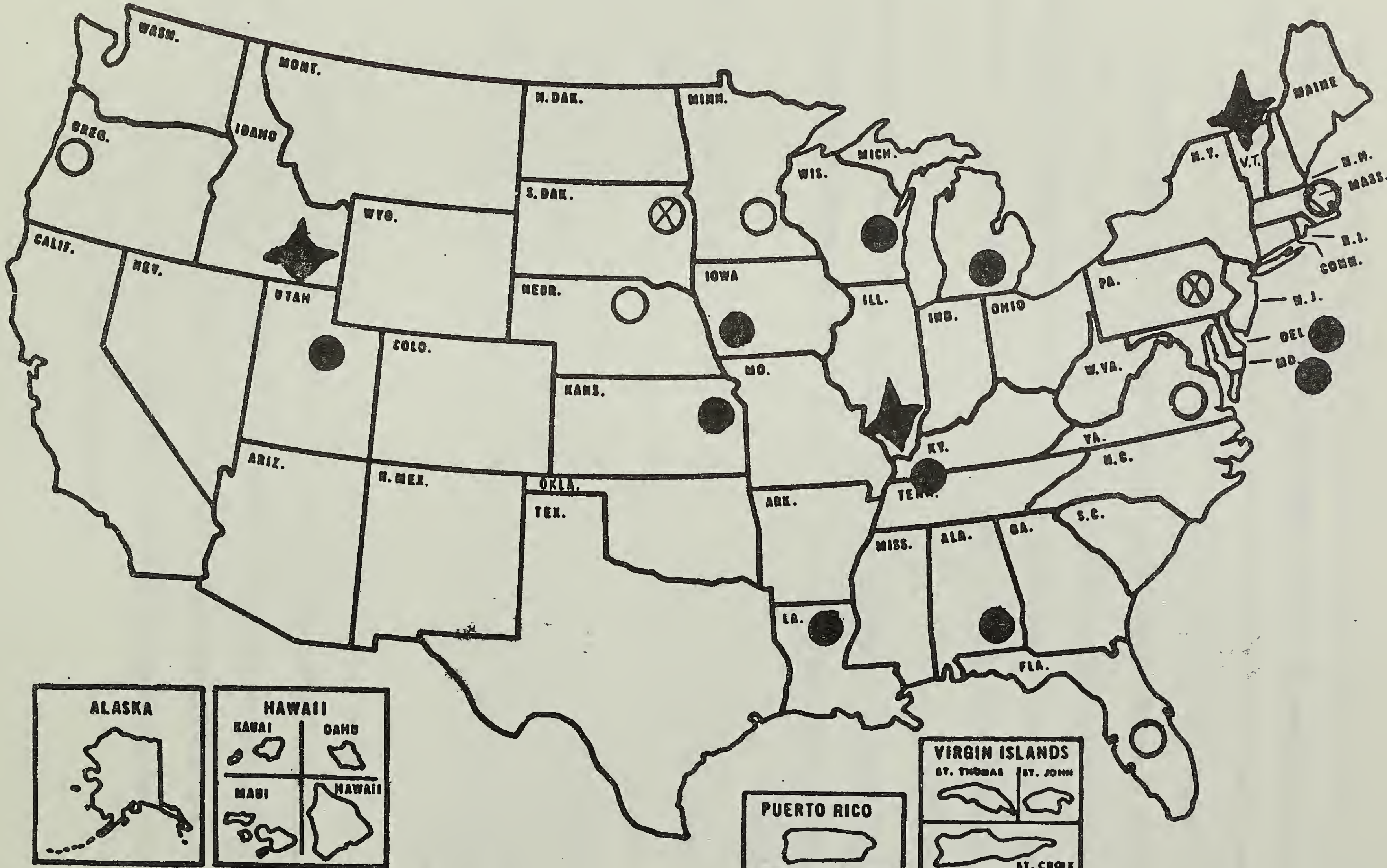
RCWP projects (Figure II-1) have been selected, and a program is underway. Rock Creek, Idaho is an irrigation project where high turbidity from return flows is endangering a trout stream. Highland Silver Lake, Illinois is a row crop and livestock project area where high nutrient loadings and sediments are impacting a drinking water supply lake. St. Alban's Bay, Vermont is primarily an animal waste management project where nutrients and high coliform counts are resulting in eutrophication and health impacts in St. Alban's Bay.

Conestoga Headwaters, Pennsylvania and Oakwood-Lake Poinsett, South Dakota are currently developing proposals to measure implementation impacts on groundwater.

All of these projects and several other projects which have been funded from other sources will be supplying monitoring data to the National Nonpoint Source Evaluation Project which has been established by interagency agreement. The goal of this project is to establish and make predictions on the effectiveness of various practices on controlling water quality related parameters.

The Agricultural Stabilization and Conservation Service (ASCS) is responsible for operating the program with technical assistance provided by SCS and other conservation agencies and groups. The Soil Conservation Service coordinates all technical services.

RURAL CLEAN WATER PROGRAM
PROJECT LOCATION MAP



● 1980 Project w/general monitoring & evaluation (GM&E)

✦ 1980 Project w/comprehensive monitoring & evaluation (Comp. M&E)

○ 1981 Projects w/GM&E

⊗ 1981 Projects w/Comp. M&E

Best Management Practices are developed at the local level and recommended by the county ASC committee. The practices are approved by the State ASC committee and the Secretary of Agriculture with the concurrence of the Environmental Protection Agency (EPA).

Figure II-2 provides a summary of the 21 RCWP projects covering in excess of 2 million acres in 22 States. It is shown that excessive nutrients (86 percent) and sediment (76 percent) are the major problems addressed. Finfish, general water based recreation and municipal water supplies are the major water uses or related resources impacted by the projects; 81, 67 and 43 percent respectively. Major nonpoint sources of pollution are erosion from intensively farmed row cropped agricultural fields and livestock operations, 81 and 71 percent respectively. The figure also shows that nearly all projects address an array of problems and water quality issues.

Some RCWP projects have accompanying comprehensive water quality monitoring and evaluation programs to track water quality progress through the project lifetime. This will provide Congress with the needed documentation to decide on the fate and future of such programs. Approximately ten percent of appropriated funds have been set aside to ensure a proper and

RCWP PROJECTS SUMMARY

PROJECT	ST	ACRES	Water Quality Problems: Sediment - Turbidity	Nutrients	Pesticides	Bacteria	Water Uses or Impacted Resources: Municipal Water Supply	Irrigation Return Flow	Shellfish	Finfish	General Recreation	Pollution Sources: Livestock Wastes	Row Crop Agriculture	General Ag. Land Erosion
1980														
Lake Tholocco	AL	51,400	x	x	x	x				x	x	x	x	x
Appoquinimink R.	DE	30,700	x	x	x				x	x		x	x	
*Rock Creek	ID	198,400	x					x		x	x		x	
*Highland Silver Lake	IL	31,000	x	x	x		x			x	x		x	
Prairie Rose Lake	IA	4,600	x	x	x					x	x		x	
Upper Wakarusa R.	KS	154,000	x			x				x		x	x	x
Bonne Idee	LA	196,000	x	x	x					x	x		x	x
Double Pipe Creek	MD	110,000	x	x		x	x			x	x	x	x	x
Saline Valley	MI	200,000	x	x		x	x			x	x	x	x	
Reelfoot Lake	TN/KY	154,000	x	x	x					x	x		x	x
Snake Creek	UT	800	x	x				x		x	x	x	x	
*St. Alban's Bay	VT	33,300	x	x		x				x	x	x	x	x
Lower Manitowoc R.	WI	102,000		x			x			x	x	x		
1980 Subtotal		(1,266,200)												
1981														
Taylor Cr.-Nubbin Slough	FL	108,000		x			x			x	x	x		
Westport R.	MA	37,000		x		x			x			x	x	
Garvin Brook	NM	30,700	x	x			x			x		x	x	x
Long Pine Creek	NE	80,000	x	x				x		x	x	x		
Tillamook Bay	OR	363,000				x			x			x		
*Conestoga Headwaters	PA	110,000	x	x	x	x	x			x		x	x	x
*Oakwood-Lake Poinsett	SD	57,500		x			x				x		x	x
Nansemond-Chuckatuck	VA	161,400	x	x		x	x		x			x	x	x
1981 Subtotal		(947,600)												
TOTAL	22	(2,213,800	16	18	7	9	9	3	4	17	14	15	17	10
% of Projects Having Water Quality Problem			76	86	33	43	43	14	19	81	67	71	81	48

*Comprehensive Monitoring & Evaluation Projects

Figure II-2

thorough evaluation of water quality. Generally, the monitoring objectives for the projects are:

1. Evaluate the success of the RCWP project in meeting water quality goals according to the plan of work, the State Water Quality Standards, and the Clean Water Act.

2. Transfer of information on Best Management Practices effectiveness to other areas of the country.

3. Provide water quality information to USDA agencies and the Environmental Protection Agency for use in evaluating the effectiveness of the RCWP program.

4. Provide water quality information to RCWP project managers to adjust projects to more accurately reach the water quality goals and objectives.

5. Develop improved water quality non-point source monitoring methodologies to be utilized in other currently planned water quality projects.

6. Identify, measure, and compare the positive and negative social and economic impacts on the landowners in RCWP projects.

COLORADO RIVER BASIN SALINITY CONTROL PROGRAM

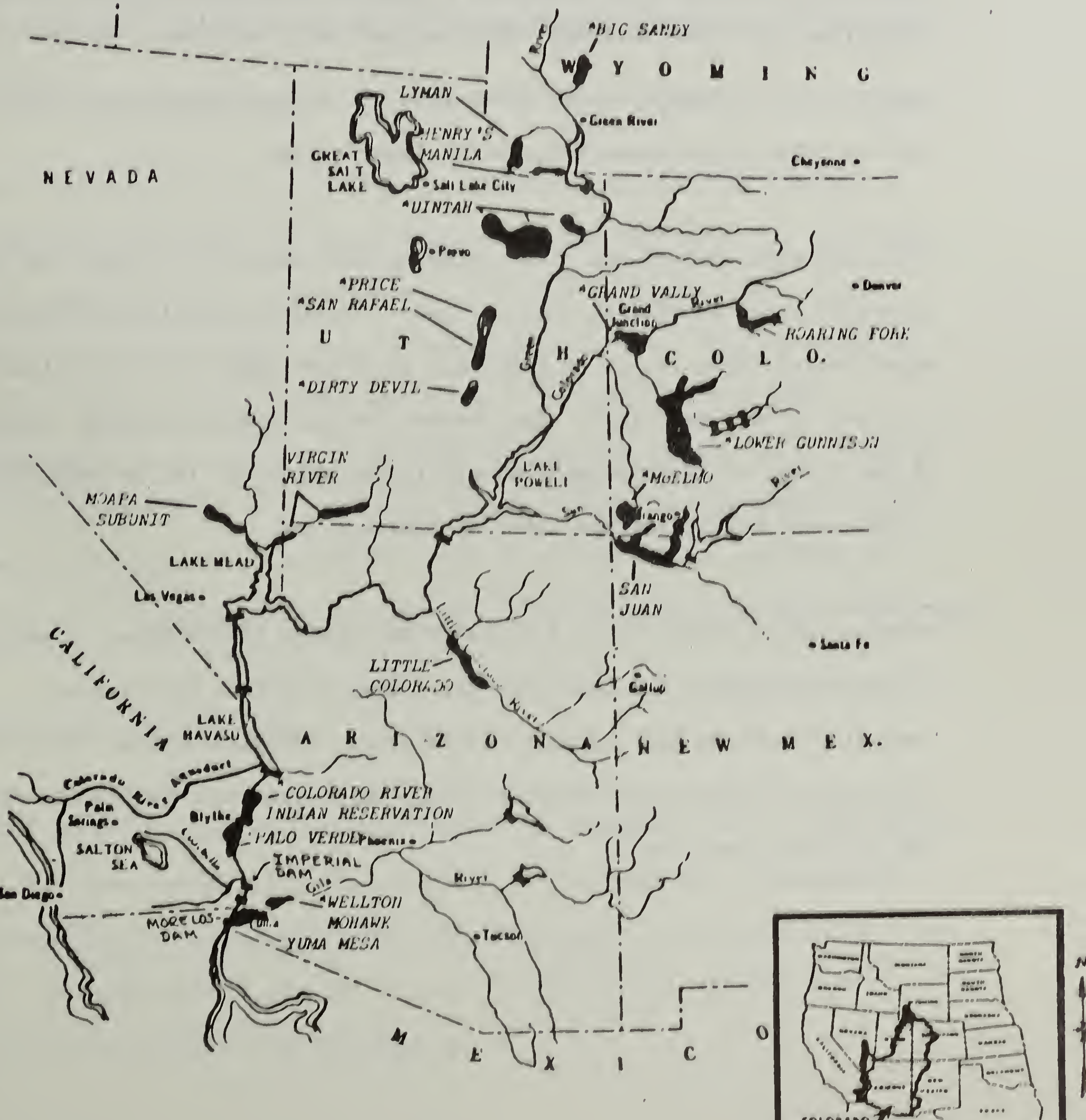
Salinity problems in the arid and semi-arid areas of the U.S. are becoming a critical concern to those involved in the management of our natural resources. The salinity problem can take two forms. One is a salinity buildup in the soil root zone that reduces or precludes an economic return from growing agricultural crops. The other is excessive salinity in lakes, streams, and rivers that reduces or precludes their use for irrigation, domestic, municipal, and industrial water supply or for fish and wildlife habitat.

The Colorado River Basin encompasses portions of seven States: Colorado, Wyoming, Utah, Nevada, New Mexico, California, and Arizona. The river is 1,400 miles long with its headwaters in Wyoming and Colorado. It empties into the Gulf of California and serves some 14.5 million people on its way. It is one of the most physically developed and regulated rivers in the Nation.

Salinity control in the Colorado River Basin is addressed in the Colorado River Basin Salinity Control Act of 1974, Public Law 93-320. The Act has two major components. One is to maintain the water quality standard agreed to on August 30, 1973, in Minute 242 of the International Boundary and Water Commission for water delivered to Mexico under the Mexican Water Treaty of 1944. This is covered in Title I of the Act which includes a large desalting plant to treat drainage return flows from the Wellton-Mohawk Irrigation and Drainage District near Yuma, Arizona.

OLORADO RIVER BASIN SALINITY CONTROL PROGRAM

IRRIGATION SALT-SOURCE AREAS HAVING
POTENTIAL FOR SALINITY CONTROL
WITH USDA PROGRAMS



Soil Conservation Service
U.S. Department of Agriculture
Washington, D.C.

The second component deals with the salinity concentration in the river above Imperial Dam and the controls necessary to meet U.S. water quality standards. This is covered in Title II of the Act.

The salinity of the water delivered to Mexico increased to nearly 1,500 milligrams per liter in 1961. This was partially attributed to the highly saline drainage return flows from the Wellton-Mohawk area which empties into the Colorado River below Imperial Dam.

The total salt load in the river entering Lake Mead above Hoover Dam is estimated to be 10 million tons per year. To meet the salinity control objective of Title II, it is necessary to remove some 2.8 million tons per year of this salt load. The present average annual salinity concentration of the river varies from about 50 milligrams per liter in the headwaters to about 820 milligrams per liter at Imperial Dam.

Average onfarm irrigation and distribution system efficiencies, especially in the Upper Basin, are generally low. Low irrigation efficiencies generally indicate high surface runoff and/or over-irrigation. Over-irrigation can result in excessive deep percolation which leaches excess salts from the soil into the river.

USDA Title I Activities

The Department of Agriculture through SCS initiated an intensive onfarm irrigation improvement program in 1974 to reduce the quantity of irrigation return flows from the 65,000 acre Wellton-Mohawk Irrigation and Drainage District.

Technical assistance and cost-share assistance is provided through contracts with individual farmers for practices that meet the objective. SCS expenditures are reimbursed by the Bureau of Reclamation. Over one-third of the planned program has been installed. This activity is supported by research of the Agricultural Research Service (ARS). Although current research is not directly related to the Title I Program of PL 93-320, the U.S. Water Conservation Laboratory continues to carry on water management research in the Wellton-Mohawk area, and this is expected to contribute to the continuing job of irrigation water management.

USDA Title II Activities

USDA activities in the Title II area are in accordance with a memorandum of agreement between SCS and the Bureau of Reclamation. Supplemental memorandums of understanding between ARS, Agricultural Stabilization and Conservation Service (ASCS), Extension Service (ES), and SCS cover coordination within the Department.

Presently, SCS is using River Basin funds for surveys, investigations, and resulting study reports, while Conservation Operations/Technical Assistance funds are used for implementing technical assistance. ASCS is using Agricultural Conservation Program (ACP) funds for cost-sharing salinity control measures. The cost-sharing rate varies from 75 to 90 percent. ARS is providing funds from their appropriation for research and ES for demonstration, information and education. Extension specialists conduct water management workshops and also work with farmers in monitoring and evaluating crop production and irrigation systems to fine-tune practices for greater economy and efficiency.

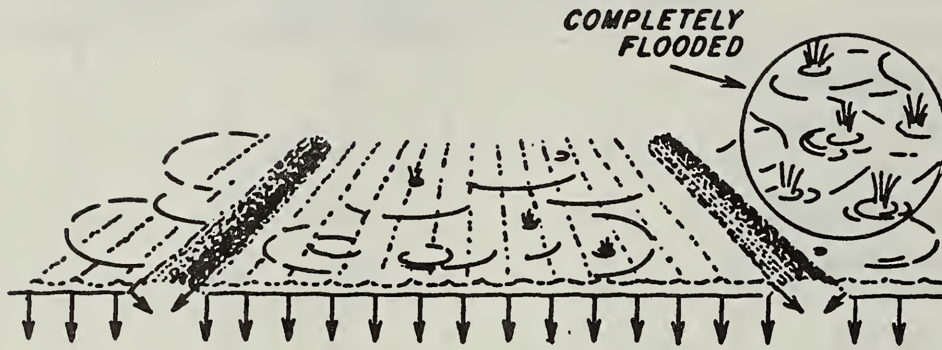
USDA in cooperation with other agencies has completed four studies and issued reports. These are for the Grand Valley Unit in Colorado, the Uinta Basin Unit in Utah, the Big Sandy Unit in Wyoming and the Moapa Valley subevaluation units of the Virgin River units in Nevada. Studies of other units are nearing completion. These are the Lower Gunnison and McElmo units in Colorado, and two additional Virgin River subevaluation units involving parts of Nevada, Utah, and Arizona.

The major benefits from the Colorado River Basin Salinity Control Program are national and regional. The national need is to reduce the salinity level in the Colorado River water delivered to Mexico in accordance with the 1973 salinity agreement. The regional need is to maintain current salinity levels in Colorado River water withdrawn for downstream use while allowing the Upper Basin to further develop its compact apportioned waters.

COLORADO RIVER BASIN SALINITY CONTROL PROGRAM STUDIES

STUDY NAME	STATUS						
	Inactive	Organized	Prel. Draft	Final Review	Published	EIS Supl.	Imple-mentation
USDA TITLE I ACTIVITIES							
Wellton-Mohawk Arizona							X
USDA TITLE II ACTIVITIES							
1. Big Sandy River Wyoming					X		
2. Lyman Wyoming	X						
3. Henry's Fork-Manila Utah and Wyoming	X						
4. Uinta Basin (Uinta Laterals) Utah					X	(done)	X
5. Grand Valley Colorado					X	(done)	X
6. Price-San Rafael Rivers Utah		X					
7. Dirty Devil River Utah	X						
8. Roaring Fork Colorado	X						
9. Lower Gunnison Basin Colorado					X	(done)	
10. McElmo Creek Co.		X					
11. San Juan River Basin (Mancos Valley) Colorado and N.M.		X					
12. Upper Virgin River Utah		X					
13. Virgin River Unit AZ, NV, UT				X			
14. Moapa Nevada					X		
15. Little CO. R.B. AZ & N.M.	X						
16. CO. R. Indian Reserv. AZ	X						
17. Palo Verde California	X						

SURFACE IRRIGATION



FLOODING

RIDGE AND FURROW

Diagrammatic representation of two surface irrigation methods for applying water to land. (Applications of Sludges and Wastewaters on Agricultural Lands, U.S. E.P.A., 1978)

P.L.-566 WATERSHED PROGRAM

The Watershed Protection and Flood Prevention Act authorizes technical and financial assistance to further the conservation, development and disposal of water, and to further the conservation and utilization of land. This broad authority provides an opportunity to address a wide range of water and related land resource problems and opportunities.

In the P.L.-566 Program water quality issues have been addressed for several years. A good example of this is the LaPlatte watershed project, approved in July, 1979, which has the objective of providing solutions to water quality problems through installing conservation land treatment and animal waste management measures. The LaPlatte plan has two parts and will be implemented over a 12 year period to 1990. Part one of the plan includes the preparation and implementation of individual conservation plans and contracts with landowners within the LaPlatte River watershed. Part two of the plan is a comprehensive water quality monitoring and analysis program. It will assess the overall effect of implementation of conservation practices on the surface water quality in the watershed and on sediment and nutrient export from the watershed.

The LaPlatte monitoring and analysis program has two major objectives:

1. Evaluation of the impact of implementation of conservation practices on the amounts of sediment, nutrients, and animal wastes entering the surface waters of the LaPlatte River watershed.

2. Evaluation of the impact of the implementation of conservation practices in the LaPlatte River watershed on the export of sediment and nutrients to Shelburne Bay, Vermont.

Recently watershed protection plans have been approved that include works of improvement primarily for the purpose of addressing water quality problems. Examples are the Lovejoy Pond Watershed in Maine and the Johnson Creek Watershed in Washington State. Problems in the Maine watershed have occurred in Lovejoy Pond where eutrophic conditions have damaged the pond for recreation, fish production and water supply. The principal contaminate causing the problem is phosphorus. Phosphorus loading from tributaries ranges from 100 to over 1,000 parts per billion (ppb), and is derived from nonpoint sources, such as barnyard runoff, manure piles, and manure from fields.

After careful evaluation of economic and environmental impacts of alternatives, plans that included only land treatment measures were selected. In the case of Lovejoy Pond the selected plan included animal waste management systems, grassed waterways, stripcropping, and associated practices. In-lake treatment was also included at a cost of $100,000. This cost will be borne by funds other than P.L.-566 Installation of the selected plan is expected to reduce agricultural related phosphorus by 85 to 90 percent. This will achieve the project goal of reducing phosphorus to Lovejoy Pond to 15 ppb or less.

The Johnson Creek Watershed in Washington has water quality problems related to instream uses. Sources of pollutants are nonpoint and originate primarily from dairy farms. The pollutants adversely affect the stream fishery, aesthetics, and recreational uses. Excess fecal coliforms, temperature, turbidity, and phosphorus are responsible for the failure

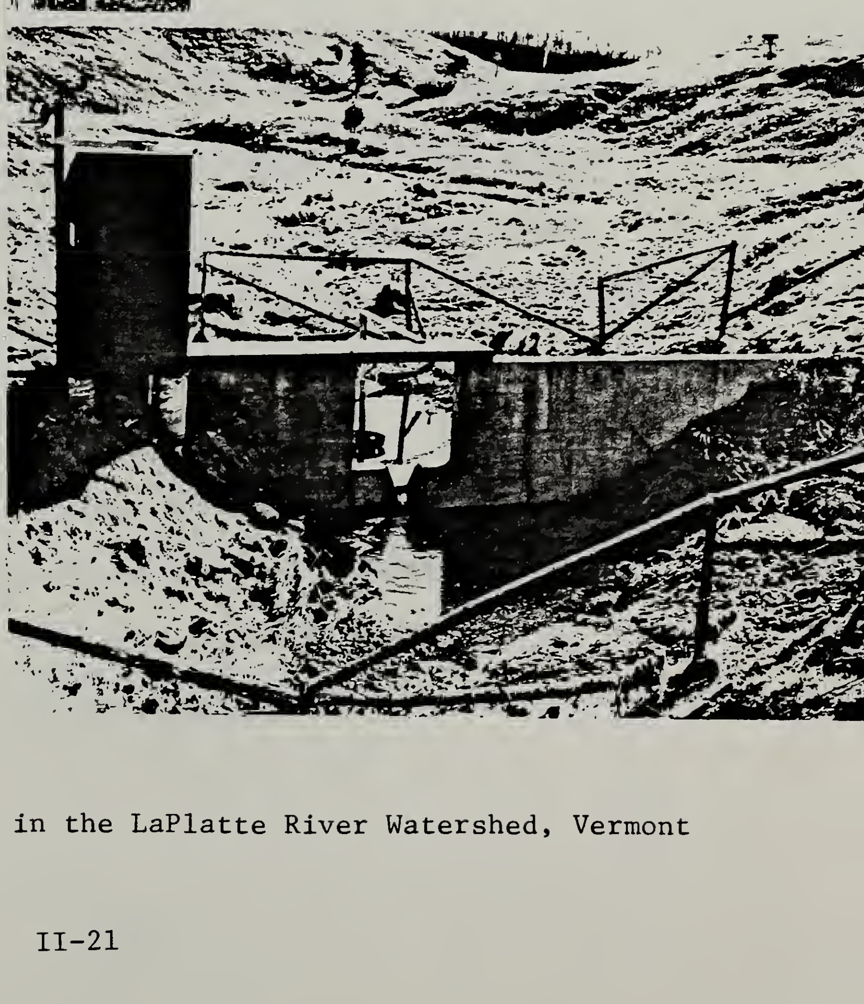
of the stream to meet established State water quality standards. The Johnson Creek plan includes animal waste management systems and fencing to prohibit access to the stream by cattle.

Both watershed plans include provisions for water quality monitoring. For Johnson Creek, the Washington State Department of Ecology will have leadership for the water quality monitoring program. The program will last 10 years and will document quantitative differences in stream loading resulting from changes in waste management practices. The practices installed will be evaluated to determine if they constitute an effective means of reducing contaminants from agricultural land. P.L.-566 funds will be used to pay $39,000 of the $120,000 total cost.

In Maine, the water quality monitoring program will cost $139,400 of which P.L.-566 funds will pay $45,200. The program will be carried out over 5 years through a Soil Conservation Service/Maine Department of Environmental Protection cooperative agreement. Typically, water quality sampling will consist of dissolved oxygen (DO), temperature profile, total phosphorus profile, epilimnetic chlorophyll core, and Secchi disk visibility. In addition pH, alkalinity, conductivity, color and Nitrogen (TKN, NO_2, NO_3, NH_3) will be analyzed.

Watershed projects where water quality is a stated objective are as follows:

- Indiana - Upper Big Blue River
- Maine - Lovejoy Pond
- North Carolina - Muddy Creek (Duplin Co.)
- Vermont - LaPlatte River
- Vermont - Lower Otter/Dead Creek
- Washington - Johnson Creek



Photos: USDA-SCS

Water quality sampling stations in the LaPlatte River Watershed, Vermont

RIVER BASIN STUDIES

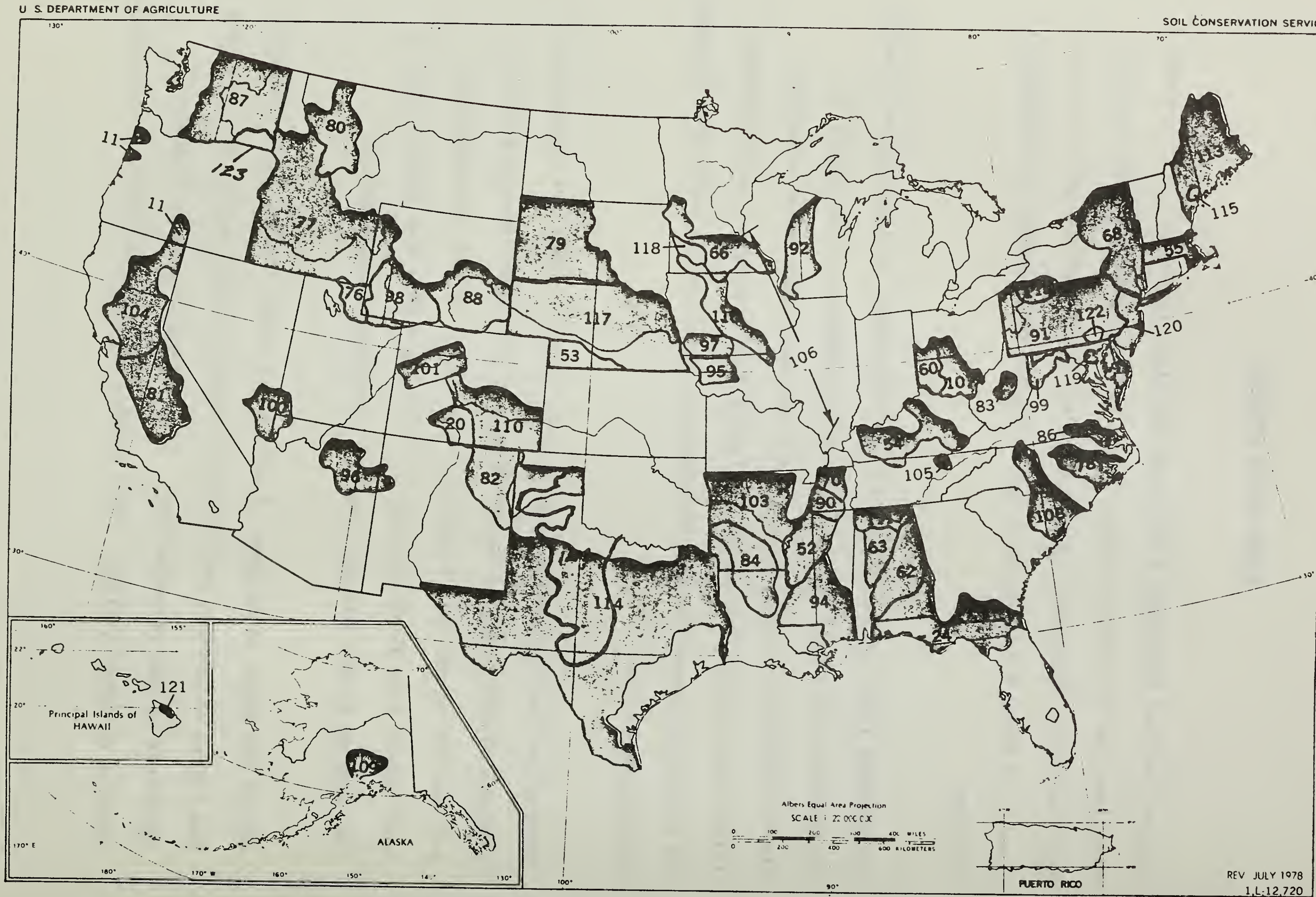
Section 6 of the Watershed Protection and Flood Prevention Act as amended authorizes the Secretary of Agriculture to cooperate with other Federal, State and local agencies to make watershed investigations and surveys of rivers and other waterways as a basis for the development of coordinated programs.

Cooperative river basin studies provide Department of Agriculture planning assistance to Federal, State and local governments. The purpose of these studies is to assist in appraising water and related resources, formulating alternative plans, including land treatment, non-structural or structural measures, or combinations thereof, which would meet existing and projected needs.

Studies are coordinated through a field advisory committee composed of representatives from the Forest Service and Economic Research Service and chaired by the Soil Conservation Service. Annual appropriations have ranged from about five million dollars during the early stages of the program to the current level of seventeen million dollars.

One of the major objectives of most river basin studies is to evaluate the impact of present and projected water and land resources management practices on the resource base. This includes certain analysis of impacts on water quality. Many studies contain provisions for inventorying

RIVER BASIN SURVEYS
COOPERATIVE STUDIES
(Type 4)
In Progress - February 1978



elements which contribute to water quality problems. This may include such things as inventorying feedlots, dairy operations, aquaculture, and soil erosion. In cases where inventory data is not sufficient, special water quality monitoring is performed through river basin studies. Studies are coordinated with State Water Quality Plans (Section 208) to avoid duplication of activities. Water quality objectives in a river basin plan are designed to enhance and complement ongoing State water quality programs.

The following river basin studies have water quality monitoring programs completed or underway:

Arizona	1957 Wellton-Mohawk Salinity Control Project--base, design, trend, model study. Bureau of Reclamation, U.S. Department of Interior and Soil Conservation Service.
	1978 Colorado River Indian Reservation Study--base, design, trend, model study. Bureau of Reclamation, U.S. Department of Interior and Soil Conservation Service.
Idaho	1980 Middle Snake River--Bundage Unit--Water Quality Monitoring.
Iowa	1980 North East Iowa Rivers--Pollution of ground water and streams limited tracer tests.
Kentucky	1976 North Elkhorn Creek and Tributary; Silver Creek, Little Kentucky River.
Tennessee	1980 Wolf-Loosa Hatohie River Basin--base data.
Texas	1980 Efforts of Salinity on Dryland-monitoring ground water and surface water--baseline and trend data.

Utah	1980 Uintah Basin Unit Colorado River Basin Salinity--Base data performed by the Utah Bureau of Water Pollution Control-operations.
Utah	Price/San Rafael--Colorado River Basin Salinity--Base data performed by Utah Bureau of Water Pollution Control-Operational.
Washington	1979 Tucannon Water Quality Study--Southeast Washington River Basin Study-base data and trends.

The following additional river basin studies contain water quality data collection and analysis performed using existing data. No monitoring was done in these areas.

Illinois	1981 Priority Lakes Study.
North Carolina	Tar Neuse River Basin using State water quality data.
Ohio	1982 Surface Mined Area--will use existing data to evaluate and inventory acid mine pollution.
Wisconsin	1981 Sugar Pecatonica River Basin Study--agricultural and erosion pollution--using State collected data.

RESOURCE CONSERVATION AND DEVELOPMENT PROGRAM

The Resource Conservation and Development (RC&D) Program was authorized by the Food and Agriculture Act of 1962 (Public Law 87-80). The Program's three major objectives are to: (1) orderly develop, improve, conserve, and use the project area's natural resources, thereby providing employment and other economic opportunities to the people of the area; (2) provide local leadership with the opportunity to more fully coordinate and use the facilities and techniques available under current agricultural programs, and any applicable new programs, to aid in planning and carrying out a balanced program of development and conservation of natural resources to meet local, State, and national needs; and (3) orderly extend the program, where needed, project by project, as local leadership is able to effectively plan and carry out the activities necessary to achieve program goals.

An amendment of August 30, 1972, (Public Law 92-419) to the Bankhead-Jones Farm Tenent Act added provisions for broadening the RC&D Program scope. This law authorizes the Secretary of Agriculture to, among other actions, provide Federal assistance for water quality management.

Water Quality Activities in the RC&D Program

RC&D measure plans developed for water quality management may be provided financial and technical assistance as described in the RC&D Handbook. Practices may include, but are not limited to, agriculture waste management systems, diversions, terraces, grassed waterways and outlets, fencing, filter strips, streambank protection, sediment basins, grade stabilization structures, and improving irrigation management systems and components. All plans for which this type of assistance is provided shall: (1) have community benefits; (2) have an RC&D measure plan concerning the plan area; and (3) be sponsored by public organizations and groups or public non-profit corporations having authority and ability to install, operate, and maintain community-type measures. All planning where water quality is the primary purpose is subject to the guidance provided by the Principles and Standards for Planning Water and Related Land Resources.

The maximum technical assistance available is 100 percent, and financial assistance may be provided for up to 100 percent of the construction costs. RC&D loans may be made up to 100 percent through funds available from FmHA. Utilization of both types of assistance for this purpose has not been widespread, but is gradually increasing.

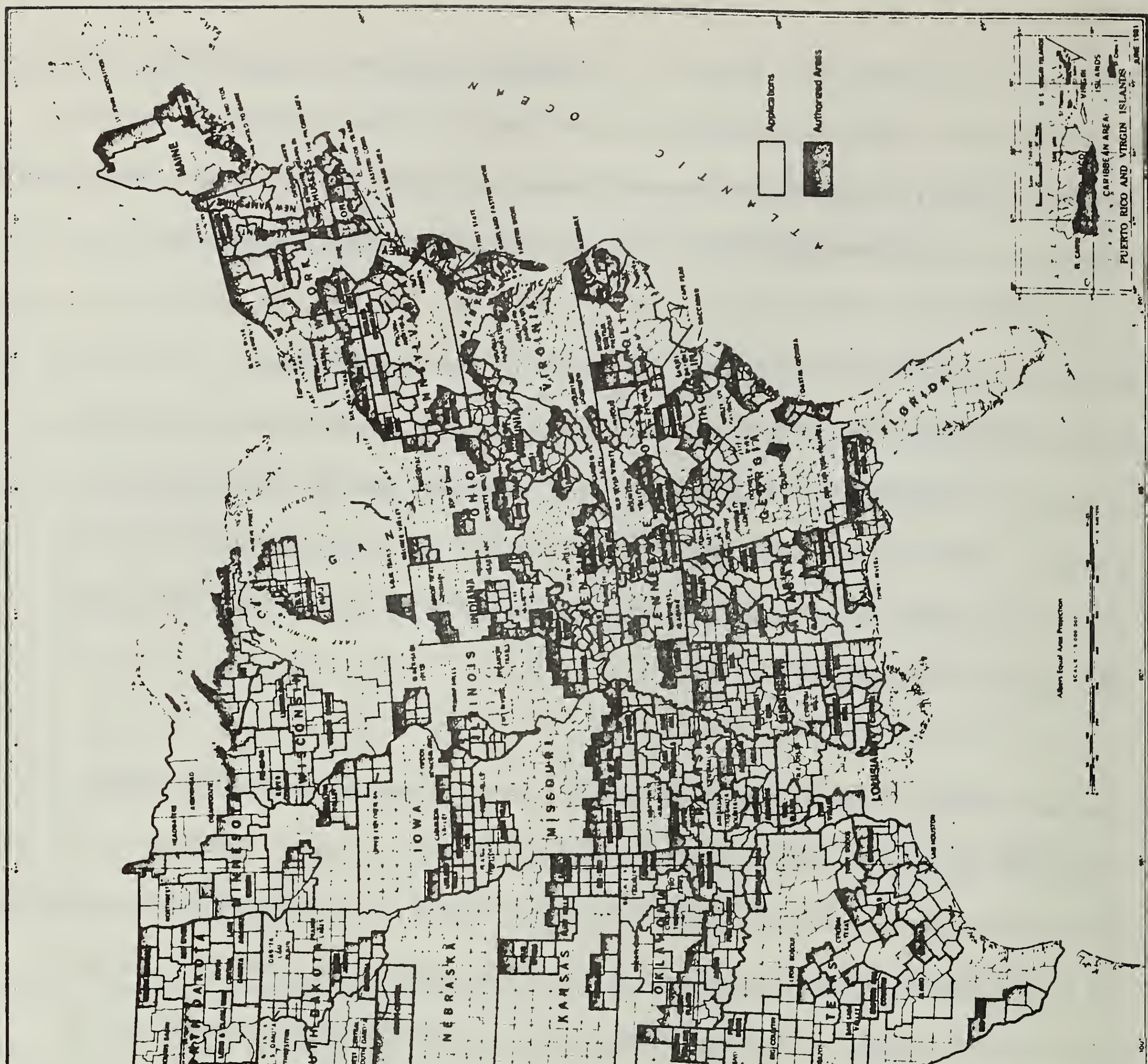
In Oregon, an associated measure (technical assistance only) dealt with possible water quality problems in the domestic water system of Seaside. The RC&D Council coordinated several meetings which helped city administrative officials determine the course of action best for their community.

The Eastern Shore RC&D Council in Virginia has developed a project proposal in cooperation with the Virginia Institute of Marine Science for funding of a water resource quality survey for non-point runoff. The survey would gather much needed information regarding the filtering impact of irrigation impoundments in an area where deep-water recharge is critical.

In the Midwest, two RC&D areas in Iowa have installed measures which impacted upon fish and wildlife habitat as well as water quality. The Talmage Hill measure in the Southern Iowa Area involved the construction of a 7.5 acre lake with a stop—log drawdown structure that can release up to 27 acre-feet of water. That water is impounded by low dikes to create an 11 acre wetland which has a favorable impact on water quality.

Upon completion of the Jefferson County Farm Measure in the Pathfinders Area, residents of the nearby Jefferson County Care Facility Center will enjoy quality fishery and related experiences. This is the result of a dam that impounds about 2 acres of water with accompanying recreation facilities. Best Management Practices to be installed on land in the drainage area will protect water quality and insure compliance with Iowa water quality standards.

RESOURCE CONSERVATION AND DEVELOPMENT STATUS



CONSERVATION OPERATIONS PROGRAM

The Conservation Operations Program, administered under P.L. 74-46, is to provide technical assistance to farmers, ranchers and others to carry out conservation activities. Technical assistance of this type is usually provided through the local Soil and Water Conservation Districts.

During the 1980 fiscal year, SCS's Conservation Operation Program provided conservation technical assistance to nearly 900,000 land users, including individuals and groups. Greater than 425,000 land users applied one or more conservation practices which contributed to water quality of the area to some degree.

It is not possible to definitively identify the impact of the Conservation Operations Program on water quality, but in many cases the conservation practices installed help a farmer or rancher to use the land in a wise manner. This assistance provides improved water quality as well as reducing erosion, and additionally many times improves production.

Installation of many conservation practices may have a significant impact on water quality. The following are some examples:

- Animal waste management systems are designed to collect and dispose of wastes to the fullest extent possible by recycling through the soil and plants. Proper installation and maintenance of such systems can maintain and improve water quality.

- Diversions, terraces, and waterways are designed to manage water, reduce erosion, and support other conservation practices. They improve water quality primarily by reducing erosion and controlling water runoff.

- Conservation cropping systems and grassland management improve water quality by reducing erosion and making better use of applied fertilizers and pesticides.

- Irrigation water management improves water quality by reducing return flows, carrying salts, sediment, fertilizer and pesticides, into streams or groundwater.

- Conservation tillage improves water quality by reducing erosion and water runoff, and by improving soil tilth and infiltration.

Resource management systems were planned as a part of conservation plans for over 21 million acres and revised on an additional 14 million acres. As a result of these conservation planning and application efforts over 45 million acres of land were adequately treated for erosion control. For the most part water quality improvements parallel conservation efforts, but at present no accurate figures exist to separate the two activities.

RURAL ABANDONED MINE PROGRAM

The Rural Abandoned Mine Program (RAMP) provides technical and financial assistance for reclaiming abandoned surface mines and areas where past deep mining for coal has left dangerous problems at the surface. It was authorized by the Surface Mining Control and Reclamation Act of 1977 and is administered by the Soil Conservation Service.

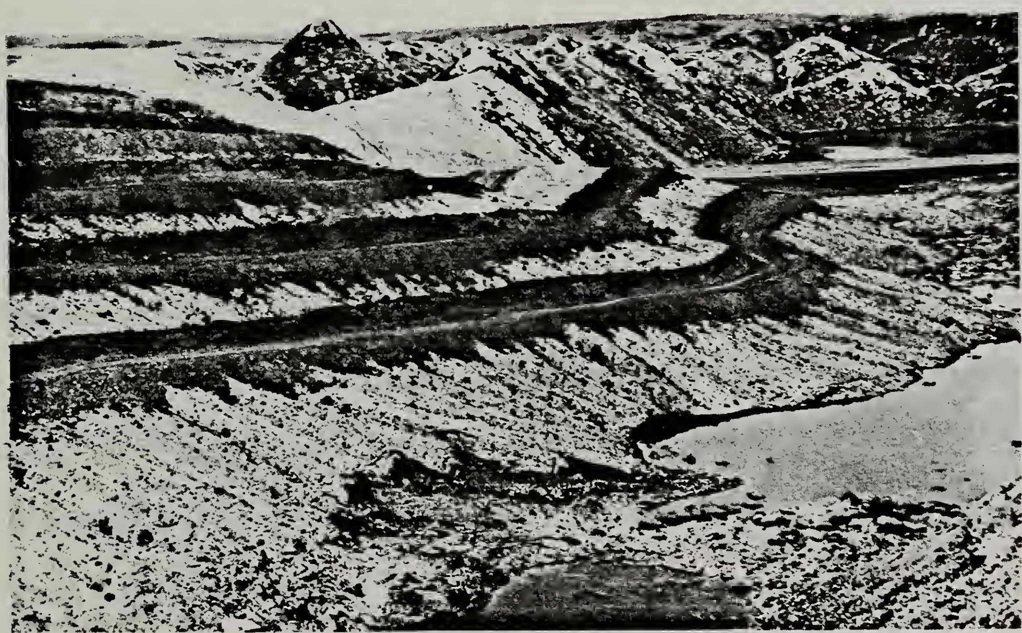
The land left in some States from past mining practices continues to degrade the environment and endangers public health, safety, and welfare as well as being an eyesore. RAMP's objective is to protect people and the environment from these past adverse effects, and to promote the development of soil and water resources of unreclaimed mined lands. In doing this, water quality and quantity were enhanced where lands have been disturbed by past coal mining practices.

The types of RAMP activities involving water quality range from abatement of acid mine drainage and protection of drinking water and groundwater supplies to filling deep-water pits and preventing acid runoff onto agricultural lands. To date RAMP contracts, involving water quality improvements, have been signed in Indiana, Iowa, Maryland, Missouri, Ohio, Pennsylvania, and Texas.

While water quality improvement is usually not the main objective in RAMP contracts, water quality often is a definite side benefit in performing reclamation. Water quality secondary benefits from RAMP can

represent significant contributions to the program, but as yet there has been no attempt to quantify these benefits. However, where water quality improvement is a primary objective, it is recorded in the data-gathering process.

There is currently proposed a RAMP tracking system for data generated in the program. Arrangements will be made to store and retrieve RAMP data through the SCS Harris computer system. When this is accomplished, more water data will be available to be summarized by county, area, State, Technical Service Center or Assistanct Chief areas, and nationally.



Above, leveling and terracing help prepare this North Dakota mine spoil for tree planting.

Photo: USDA-SCS

GREAT PLAINS CONSERVATION PROGRAM

The Great Plains Conservation Program (GPCP) is currently celebrating twenty-five years of progress in the Great Plains, including progress in solving water quality problems. The objective of the Great Plains Program is to maintain the soil and water resource base in the ten Great Plains States by helping farmers, ranchers, and others install conservation practices on their operating units. This is accomplished through a program of scheduled technical assistance and long-term contractual cost-sharing to bring improved economic and social stability to the Great Plains area.

The Great Plains Program: (1) accelerates the conversion of cropland not suited for continuous cropping to less intensive use; (2) prevents deterioration of crop and grazing land; (3) enhances fish, wildlife, and recreational resources; (4) promotes economic use of land; (5) controls or abates agricultural related pollution by establishing conservation systems to develop and maintain optimum agricultural stability and an improved environment for all the people. Participating States include North and South Dakota, Montana, Wyoming, Colorado, Nebraska, Kansas, Oklahoma, New Mexico, and Texas. Generally, while concern in the Great Plains has centered on water quantity, water quality has played an important role in the area.

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The Great Plains Conservation Program law was amended in 1969 to provide cost-sharing on practices that reduce or control agriculturally related pollution, but the inclusion of these practices in the farm plan is the exclusive decision of the land owner or operator. The practices, Waste Treatment Lagoons, and Waste Holding Ponds and Tanks were considered as having water quality as their major purpose, and were included in the list of GPCP eligible practices. In 1979 approximately $408,000 was obligated for these practices out of a total GPCP outlay of $21,543,000. In 1980, 51 of these practices were installed in the area with a total cost-share of $200,858.

While only a small percent of GPCP funds go directly to benefit water quality, there are water quality benefits achieved with the application of many GPCP practices. However, the methodology is not available to determine what percentage this may represent. Many practices for reducing erosion and controlling soil loss also improve water quality.

Below is shown State cost-share figures during 1980 for waste treatment lagoons and waste holding ponds and tanks:

State	Waste Treatment Lagoons		Waste Holding Ponds/Tanks	
	Number	Cost-share	Number	Cost-share
CO	-	-	1	$1,637.79
KS	1	$1,463.99	-	-
MT	-	-	1	3,964.56
NE	3	3,027.15	3	2,114.56
NM	-	-	-	-
ND	-	-	15	63,786.59
OK	2	5,075.61	-	-
SD	7	24,485.05	17	94,930.92
TX	-	-	1	371.48
WY	-	-	-	-
Totals	13	$34,052.00	38	$166,806.00

III WATER QUALITY INTEGRATION

HOW SCS WATER QUALITY ACTIVITIES ARE INTEGRATED

With several SCS staffs at the national level having water quality responsibilities, each office must constantly be aware of the water quality needs of other offices to properly institute projects and effectively carry out problem objectives. This process is accomplished especially through the activities of the Program and Technical Integration (PATI) Committee.

The committee, established in 1980, provides a forum for discussion of SCS water quality matters. It is chaired by the Director of the Water Quality Project Implementation Staff, which oversees the monitoring and evaluation of project and program effectiveness in achieving stated water quality objectives. Meetings are held approximately every four to six weeks. The 1981 membership of the committee has a broad representation of SCS offices as indicated in Figure III-1. The hallmark of the committee is the cooperative spirit existing among the members to accomplish the integration of water quality tasks into all SCS programs.

The committee or its subcommittees are currently tackling some issues or projects which will have a profound influence on future water quality direction for SCS. A subcommittee, co-chaired by Ecological Sciences and Water Quality Project Implementation, is undertaking revision of the 1976 Environment Memorandum-16 on Water Quality. The effort is just beginning, but basic objectives will be to give clear policy and procedure directions.

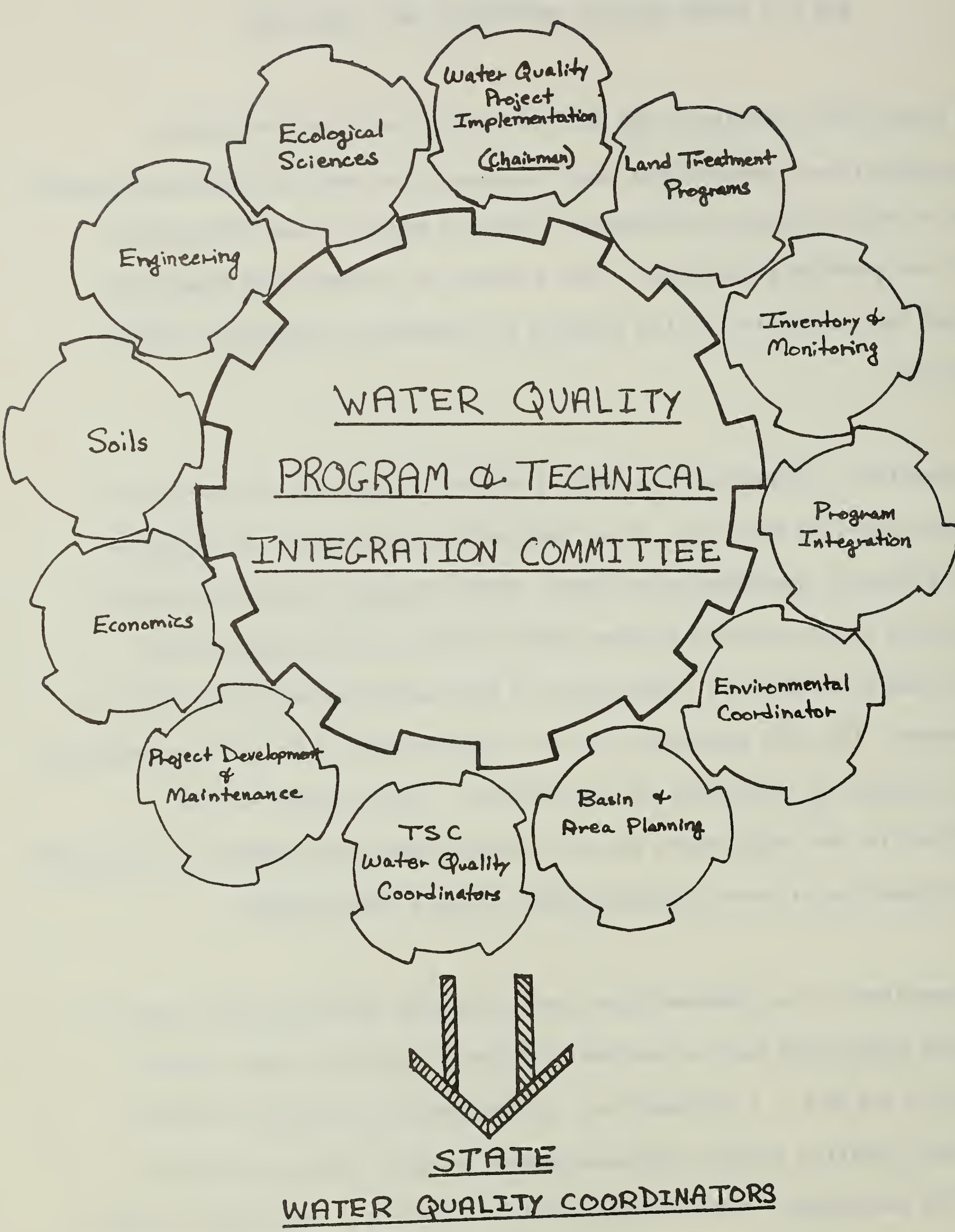

Water Quality
Project
Implementation
(Chairman)
Ecological
Sciences
Land Treatment
Programs
Engineering
Inventory &
Monitoring
WATER QUALITY
PROGRAM & TECHNICAL
INTEGRATION COMMITTEE
Soils
Program
Integration
Economics
Environmental
Coordinator
Project Development
&
Maintenance
Basin &
Area Planning
TSC
Water Quality
Coordinators
STATE
WATER QUALITY COORDINATORS

Figure III-1

Another effort of the committee is the guidance and review of a comprehensive water quality training program for SCS to be instituted at all levels. A course design is being conducted by the Employee Development and the Water Quality Implementation Project staffs with assistance from Technology Development and Application personnel Staffs. This integrated approach is necessary to create a comprehensive water quality training program and will give to SCS personnel the knowledge and tools necessary to accomplish meaningful water quality tasks in their daily conservation efforts.

Development of a Water Quality Field Manual is an effort to focus water quality materials into a single comprehensive document. The manual will be placed in all field offices and is being prepared by Carl Anderson of Missouri. The Water Quality Project Implementation Staff has responsibility as the Contracting Officer's Representative. Completion of the manual is scheduled for mid-1982.

The offices represented on the Program and Technical Integration Committee are:

Deputy Chief for Natural Resource Projects

Water Quality Project Implementation
Basin and Area Planning
Project Development and Maintenance

Deputy Chief for Technology Development and Application

Ecological Sciences
Engineering
Economics

Deputy Chief for State and Local Operations

Land Treatment Programs

Deputy Chief for Natural Resource Assessments

Soils
Inventory and Monitoring

Deputy Chief for Planning and Evaluation

Program Integration

WATER QUALITY TRAINING IN SCS

Water quality is a significantly important part of SCS's mission, with water quality training a key to successfully integrating water qualitv into SCS Operations. At present, comparatively few people in SCS have sufficient water quality backgrounds to adequately carry out the water-related tasks of the Service. A comprehensive program of water quality training is needed at all levels of competence in SCS. This ranges from simple awareness to the ability to teach others within the Service.

The training program is one of sheer numbers. In September 1981, a team of SCS professionals from across the country examined water quality training needs of the Service. The Water Quality Course Design Team estimated that approximately 4,000 District and Area Conservationists and others would need water quality training to properly perform their duties. Viewed in this light, water quality training becomes an awesome task and needs to be undertaken with careful planning and concerned guidance and counsel of knowledgeable people.

In the last few years,water quality training in SCS has been sponsored on an *ad hoc* basis by the Water Quality Project Implementation Office. Cornell University conducted four two-week water quality training workshops. The workshops have been instrumental in introducing SCS personnel to the scope of water quality problems associated with SCS activities, but the workshops have more importantly indicated the real need for all SCS personnel to know about water quality problems in their everyday work. A not untypical response of many SCS people taking the course has been to incorporate water quality aspects into their daily functions, especially

at the field level. Clearly the need is there, but the magnitude of the training problem coupled with the numbers of SCS people to be trained have prevented a total program from being implemented.

The SCS Water Quality Course Design Team intensely focused for the first time on the entire scope of water quality problems and opportunities in SCS. The group found that the water quality arena in SCS is much larger than they had previously suspected. While most know of SCS's involvement in water quality project monitoring and the animal waste problems, few had suspected the broad scope that they eventually developed on water quality. They found significant water quality implications for SCS in everything from the RAMP program and Western irrigation to wetlands and conservation tillage. The realization of the magnitude of SCS's involvement in water quality is growing rapidly.

The results of the ad hoc group are now under review by various SCS water quality specialists at the Technical Service Centers and the National Office. At a meeting in late 1981 the National Training Committee instructed the SCS Educational Development Unit to develop a water quality pilot training program during 1982. If the pilot program proves successful expanded water quality training for SCS personnel will be considered.

IV WATER QUALITY INVESTIGATIONS AND ACTIVITIES IN SCS

WATER QUALITY INVESTIGATIONS AND ACTIVITIES

Water quality investigations and activities involve planning, implementation and monitoring functions in SCS. The investigations and activities address different problems and have differing objectives. While water quality represents a common theme, it is accomplished in a variety of ways in SCS.

Water quality investigations and activities are associated with SCS program projects and studies (Watershed projects, River Basin studies, Rural Clean Water Program investigations). The investigations and activities resulted from instituting Environment Memorandum-16 in 1976. The investigations analyze and interpret water quality information in relation to SCS program actions. The investigations are performed before, during, and after construction of a project which could affect the water quality of an area. During 1982, Environment Memo-16 will be revised to better reflect current circumstances and ways to obtain water quality information.

Figure IV-I illustrates the number of water quality investigations and activities conducted in SCS programs according to the water quality data submitted by the State SCS offices to the Technical Service Centers. The data shown is for calendar year 1980. In some cases it was not possible to obtain entirely accurate 1980 figures. This was especially true in water quality investigations and activities where figures usually quoted were approximate figures for a five or ten year period. In those

situations an average was used until such time that more accurate information can be gathered. Discrepancies will be found between the categories of water quality data reported in one State versus the categories reported in another State, e.g. acreage and expenditures. Some States reported expenditures, but not acreage, and the reverse was true also. With the revision of Environment Memo-16 the reporting procedures will become more consistent between States.

Out of a total of 171 investigations and activities for the year, the greatest number of projects involving water quality were in the P.L.-566 Watersheds Progrsm (53%), followed by Conservation Operations (11%) and the Rural Abandoned Mines Program (10%). The summary table below lists investigations and activities for 1980 and their relative standing.

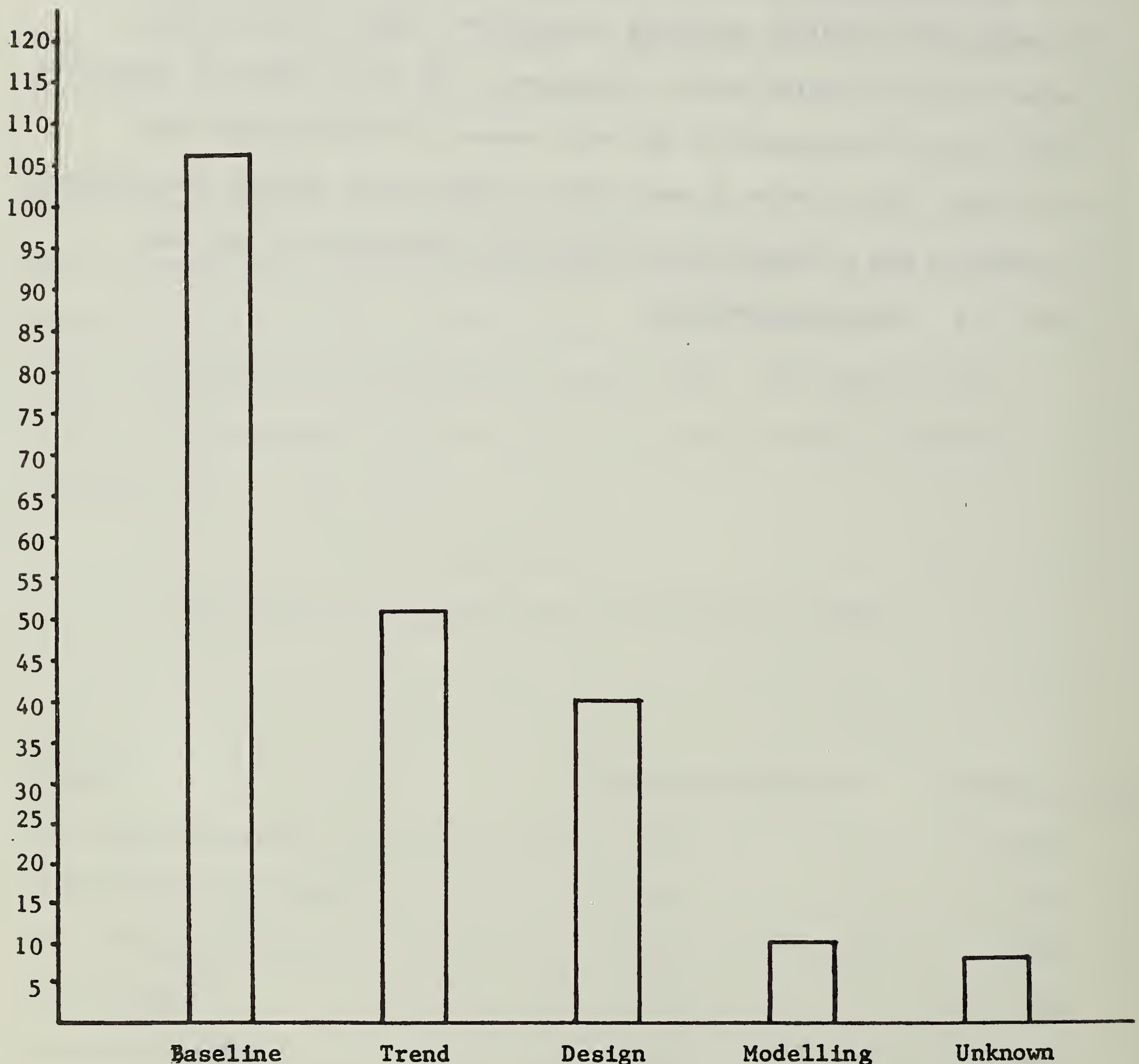
Figure IV-1

Water Quality Investigations and Activities in 1980

Program	Activities Reported	Percent of Total
P.L.-566 Watersheds	91	53%
Conservation Operations	19	11%
Rural Abandoned Mines	17	10%
River Basins	14	8%
Rural Clean Water	13	8%
Resource Conservation and Development	5	3%
208 Planning	5	3%
Model Implementation	7	4%
Total	171	100%

According to water quality data objectives, it is found (Figure IV-2) that the largest number of water quality investigations or activities (107) were to obtain baseline information, while forty activities or investigations were for design purposes. Fifty-one water quality activities were to determine water quality trends, while ten projects were performed to gather water quality modelling information. Eight projects were unspecified as to water quality objectives. The total number of objectives (216) does not correspond to the total number of investigations and activities (171) because in many cases a single water quality investigation or activity was performed to satisfy several objectives at the same time, e.g. trend and modelling.

NUMBER OF WATER QUALITY INVESTIGATIONS AND ACTIVITIES (1980)



WATER QUALITY DATA OBJECTIVES Figure IV-2

WATER QUALITY INVESTIGATIONS AND ACTIVITIES AREAS

Figure IV-3 shows water quality investigations and activities reported for 1980 by State. Several States (Nevada, Mississippi, and Utah) have two million or more acres affected by water quality projects with Nevada and Mississippi having in excess of five million acres. West Virginia, Louisiana, California, and Montana have water quality investigations and activities influencing over 600,000 acres in each State. The total acreage for all States for which water quality activity has been instituted in 1980 is 18,792,962 acres. Caution is urged in the use of these figures because they represent only estimates of the acreages involved. Some States show large acreages influenced by water quality activities, but these numbers may represent the entire watershed even though the water quality improvements were concentrated in or very near the watershed's rivers. There is usually a lesser water quality impact away from the rivers, and it is difficult to determine impacts as the distance from the rivers increases.

Figure IV-3

Acreages Influenced by Water Quality Activities

Nevada	5,736,800	Massachusetts	102,600
Mississippi	5,062,236	Alabama	80,761
Utah	2,911,700	Georgia	66,952
West Virginia	961,646	Virginia	55,200
Louisiana	788,428	North Carolina	49,540
California	724,255	Connecticut	25,152
Montana	647,292	New Hampshire	15,700
Colorado	351,492	New Jersey	11,553
Texas	343,300	Hawaii	10,532
Arizona	246,096	New York	2,960
Vermont	205,641	Pennsylvania	354
Kentucky	199,000	Oregon	26
Indiana	193,746	Total	18,792,962

EXPENDITURES FOR WATER QUALITY

Expenditures for 1980 water quality investigations and activities are significantly higher than those reported for 1979. Figure IV-4 shows the amounts of money by State attributed to water quality activities. California, Colorado, Nevada, Idaho, and Vermont have the highest totals among the States with amounts ranging from $200,000 to $2.6 million. Illinois, Missouri, Mississippi, and Kentucky form a grouping at a level between $100,000 and $156,000. All other States had expenditures for water quality activities below $100,000.

1980 EXPENDITURES ON WATER QUALITY INVESTIGATIONS AND ACTIVITIES

FIGURE IV-4

Colorado	$2,650,164	Alaska	$36,795
California	485,050	Tennessee	31,442
Nevada	331,682	Minnesota	30,442
Idaho	225,494	North Dakota	28,100
Vermont	203,700	Utah	27,800
Illinois	156,300	West Virginia	22,748
Missouri	135,600	Iowa	11,916
Mississippi	115,700	Georgia	10,400
Kentucky	103,200	Montana	9,435
Alabama	75,350	New York	8,900
Massachusetts	71,000	Washington	6,000
Kansas	67,743	Hawaii	4,100
Virginia	66,140	Maryland	2,800
Maine	55,000	Pennsylvania	2,046
Indiana	51,800	New Mexico	1,000
North Carolina	45,250	New Hampshire	600
Ohio	40,200	Wyoming	159

The increased expenditures for water quality, especially those in the West, are due to the creation of the Experimental Rural Clean Water Program (RCWP) and the expansion of the Colorado River Salinity Control Program. These new or expanded water quality activities resulted from Congressional action. No single program was solely responsible for the large increase in expenditures.

A comparison of 1979 expenditures and water quality activities with those of 1980 are of interest. The figures are classed by Technical Service Center areas.

	Activities Reported		Expenditures	
	1979	1980	1979	1980
South TSC	19	30	$114,116	$381,342
Northeast TSC	54	38	232,505	432,934
Midwest TSC	21	36	688,119	513,030
West TSC	68	61	152,685	3,777,679
Total	162	165	$1,187,425	$5,104,985

PROJECT STATUS

The reporting system used to date for the State water quality reports has three categories to show the status of water quality investigations and activities: Planning; Operational; and Completed. The breakdown of water quality investigations and activities of 1980 is as follows:

Planning	-	54
Operational	-	58
Completed	-	21
Status undetermined	-	38
Total	-	171

While the number of investigations and activities for which no status was given is significant, a relative standing indicates that many of the activities are in the planning/operational phases. The number of completed projects may actually be smaller than the 21 shown because some projects may have been completed in 1979 or before, but still reported in 1980. Some of the above water quality activities and investigations were performed by SCS personnel, but often a private contractor is hired to perform the water quality studies. Both types are reported here.

V SUCCESS STORIES

WATER QUALITY SUCCESS STORIES

In the following section are four reports on water quality activities being conducted within SCS. These water quality "success stories" are to demonstrate water quality technology and capability. The reports are from activities occurring in each of SCS's Technical Service Center areas. The Great Lakes article is different from the other articles. It is an effort involving a broad cross-section of agencies and disciplines to address regional Lake Erie water quality problems. We thank the authors who gave their time and efforts to assemble the report so other SCSers around the Nation can learn and put into practice the lessons and experiences of these people.

Photo: U.S. Fish and Wildlife Service

Good water quality provides livable habitats for both animals and man.

WATER QUALITY PROGRAMS IN THE GREAT LAKES

George Stem
Water Quality Project Implementation
Soil Conservation Service
Washington, D.C.

Following the April 15, 1972 United States/Canada signing of the Great Lakes Water Agreement, the Great Lakes Pollution from Land Use Activities Reference Group (PLUARG) was created. This binational group consisted of 9 Canadian and 9 U.S. members. The U.S. interests were represented by Soil Conservation Service Chief Norman Berg, who also served as Co-chairman for PLUARG. Focus of the reference group was the study of pollution from land use activities with a major thrust toward non-point pollution sources.

From 1972 to 1978, PLUARG undertook extensive studies of land use activities, potential pollution sources, pilot watershed studies, Great Lakes water quality impairment assessments, public consultation panels, farmer surveys, problem areas and contributing area assessments, and overview modelling of various implementation management strategies. Ultimately the PLUARG Final Report, "Environmental Strategy for the Great Lakes System" was submitted to the International Joint Commission (IJC) in July 1978.

The following are highlights and recommendations of PLUARG and the IJC:

1. Develop Management Plans focusing on high priority river basins, watersheds, potential contributing areas, and hydrologically active areas.

2. Target non-point source pollution control to sediment and phosphorus, consistent with the International Water Quality Agreement.

3. Use existing Planning and Implementation mechanisms.

4. Involve local leadership in problem identification, planning and implementation with State, Provincial, and Federal levels providing overview.

5. Accent voluntary approaches to non-point source programs with emphasis on preventative controls and low-cost remedial measures.

6. Develop and implement information-education programs for agricultural and urban areas.

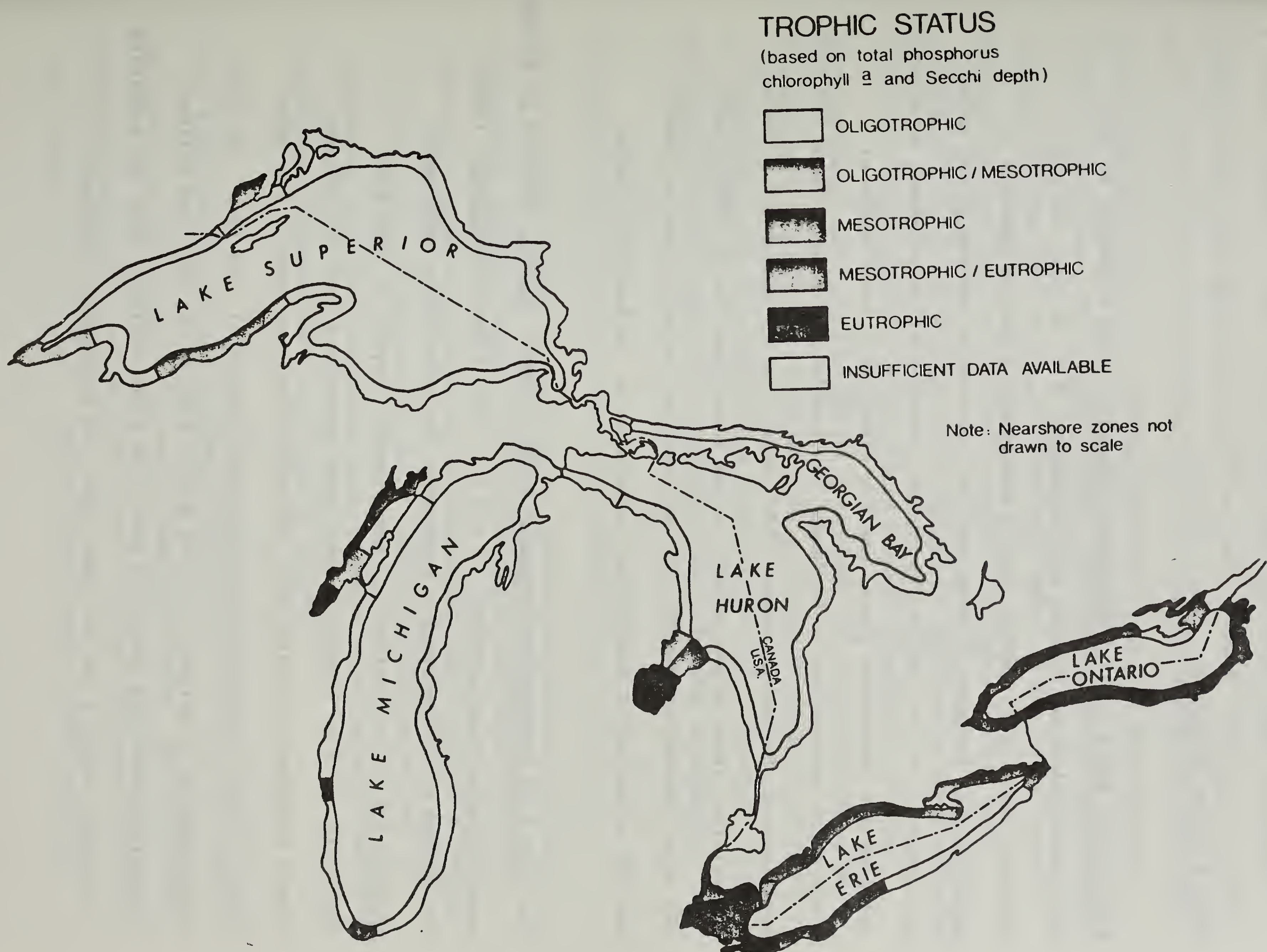
7. Provide technical assistance for both agricultural and urban areas.

8. Provide financial support for educational and technical assistance staffing, and for farmer and municipal participation.

9. Establish or expand water quality monitoring and surveillance programs.

10. Review and evaluate non-point source programs to address management plans and strategies, implementation programs, and monitoring findings.

The IJC, created by the Boundary Waters Treaty of 1909, seeks solutions to common problems in the Great Lakes. The IJC reviewed the PLUARG Final Report and conducted numerous public hearings throughout the Great Lakes basin. Subsequently, the IJC developed its final conclusions and recommendations for the U.S. and Canadian governments in a report to the two governments on February 7, 1980.



NEARSHORE TROPHIC CONDITION OF THE GREAT LAKES

Source: PLUARG

United States Projects

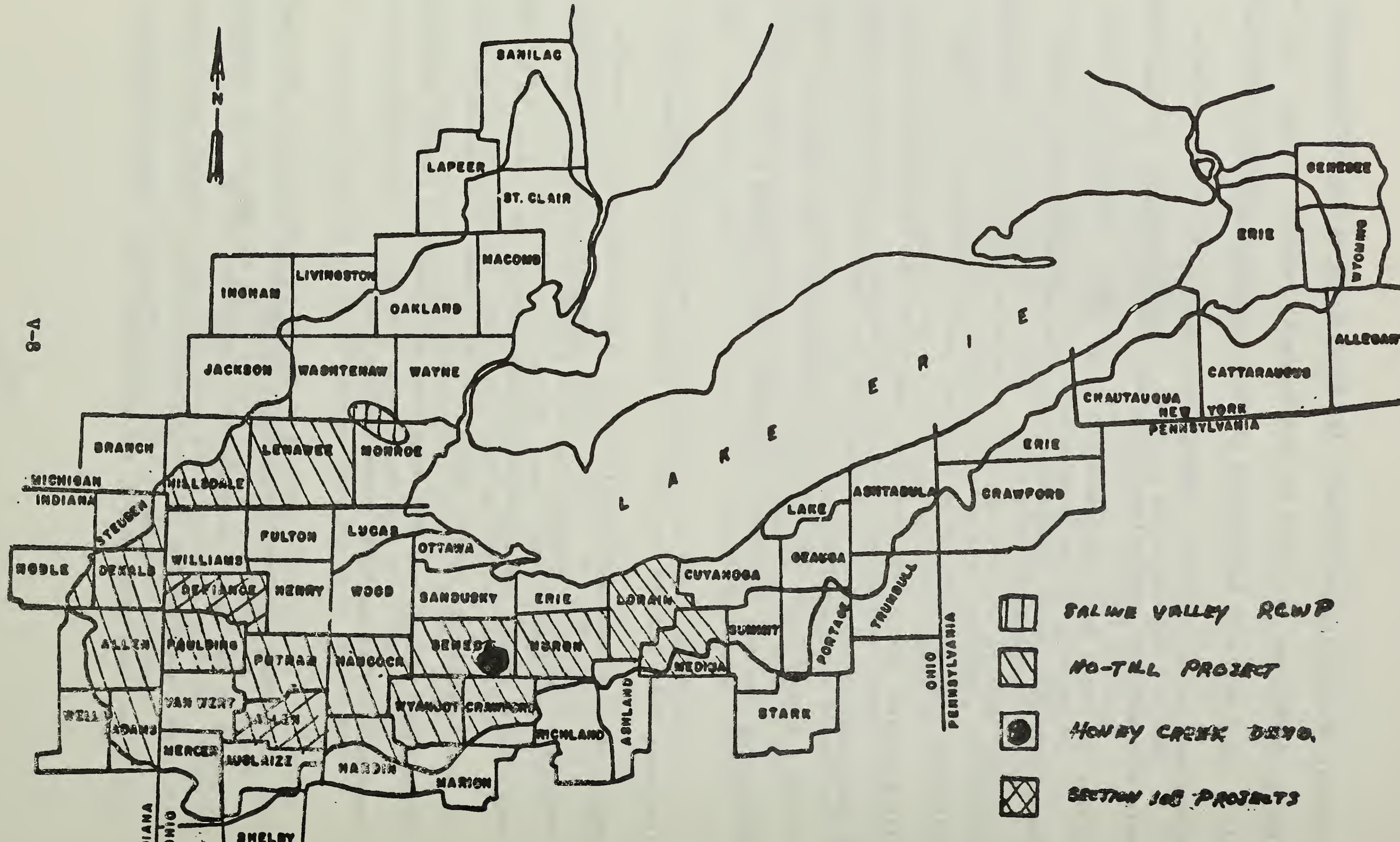
Section 208 Water Quality Management Planning under authority of the 1972 Water Pollution Control Act Amendments (P.L. 92-500) has been on-going since 1973. Water quality management planning agencies in seven special designated areas and four state-wide non-designated areas are responsible for identifying regional water quality problems, developing solution and management plans, and for identifying local units of governments responsible to implement the remedial programs. Under the U.S. Environmental Protection Agency (EPA) water quality management planning authorities, three major priority areas identified for FY 1980-84 are: (1) urban stormwater runoff; (2) agricultural non-point source runoff; and (3) ground-water protection, especially in the Lake Erie Basin.

The Lake Erie Wastewater Management Study (LEWMS - Section 108(d) P.L. 92-500), under planning responsibility of the U.S. Army Corps of Engineers (COE), is charged with developing a demonstrational wastewater management program for rehabilitation and environmental repair of Lake Erie. Initiated in 1974, efforts to date have determined that the average annual phosphorus loading of 20,000 metric tons per year is the major factor in the accelerated eutrophication process of Lake Erie. Of this, approximately 45 percent or 9,000 metric tons is derived from diffuse, non-point source and about the same from point sources, with the remaining 10 percent coming from the upper lakes and atmospheric loadings.

A special demonstrational project, The Honey Creek Watershed Management Program (HCWMP) was initiated in 1978 as part of LEWMS. Through contracts with a Joint Board of Supervisors of Huron, Crawford and Seneca Soil and Water Conservation Districts (SWCDs) funds were provided for technical assistance manpower, educational programs, and application of conservation tillage and other Best Management Practices (BMPs). Objectives were to demonstrate that local agricultural agencies and SWCDs working with individual farmers could bring about changes in agricultural land management practices. Major thrusts were directed towards conservation tillage with increased one-to-one technical assistance and demonstration plots. A comprehensive inventory of needed BMPs and identification of priority critical areas for the 120,000 acre watershed has been completed. Two monitoring stations have been established and are being maintained.

The Honey Creek project has been used extensively as a showcase and model for other conservation districts, States, and several Canadian agricultural groups. Emphasis has been placed on the local farmer and agricultural agency participating through county task forces in planning for implementing the entire project. Additional funding support for conservation tillage and BMPs have been provided by a special Agricultural Conservation Program (ACP) water quality project.

Five additional Watershed Management Studies have also been undertaken as a part of the Lake Erie Wastewater Management Study. The studies are scattered throughout the Lake Erie basin to look at different critical land forms, land uses, soils, and geographic areas. These selected


N
SANILAC
LAPEER
ST. CLAIR
INGHAM
LIVINGSTON
OAKLAND
MACOMB
JACKSON
WASHTENAW
WAYNE
BRANCH
HILLSDALE
LENAWEE
MONROE
MICHIGAN
INDIANA
STEUBEN
NOBLE
DEKALB
WILLIAMS
FULTON
LUCAS
OTTAWA
DEFIANCE
HENRY
WOOD
SANDUSKY
ERIE
LORAIN
CUYAHOGA
LAKE
GEAUGA
ASHTABULA
ERIE
CRAWFORD
ALLEN
PAULDING
PUTNAM
HANCOCK
SENECA
HURON
MEDINA
SUMMIT
PORTAGE
TRUMBULL
VAN WERT
ALLEN
WYANDOT
CRAWFORD
RICHLAND
ASHLAND
STARK
ADAMS
MERCER
AUGLAIZE
HARDIN
MARION
SHELBY
INDIANA
OHIO
OHIO
PENNSYLVANIA
L A K E   E R I E
CHAUTAUQUA
CATTARAUGUS
ALLEGANY
NEW YORK
PENNSYLVANIA
ERIE
GENESEE
WYOMING
SALINE VALLEY RCWP
NO-TILL PROJECT
HONEY CREEK DEMO.
SECTION 108 PROJECTS

watersheds provide a good representation of different conditions in the basin. The five basins are: South Branch Cattaraugus Creek (NY); West Branch Rocky River (OH); Bean Creek (MI); Ottawa River (OH); and the Sandusky River (OH). The studies are involving local agricultural agencies and agricultural interest groups in the study process. Each study includes baseline water quality monitoring data, identification of major problems, needed BMPs for watershed treatment, and proposed implementation work programs. Educational programs, technical assistance and administration, estimated costs, and proposed implementation schedules are a part of each report.

The Saline Valley Rural Clean Water Project (RCWP), as part of the Experimental Rural Clean Water Program in Washtenaw and Monroe counties Michigan, is a 200,000 acre program initiated in 1980. The Secretary of Agriculture with concurrence of the EPA Administrator is authorized to enter into contracts with landowners for installing BMPs to control non-point source pollution. The Saline Valley project was one of 13 experimental RCWP programs approved and funded through the USDA Agricultural Stabilization and Conservation Service (ASCS). Portions of Mill Creek, the Saline River, and the River Basin watersheds are included in the project.

Administered through the local ASC county committee, technical and educational manpower support is being provided with RCWP funds with BMP cost-share incentives. Major problems being addressed are cropland erosion, and animal waste management. There are a variety of soils, sloping lands, and drainage conditions in the watershed. Project life expectancy is 6 to 8 years.

U.S. EPA Section 108 Great Lakes Demonstration Projects have been initiated in different areas of the Lake Erie basin since 1972. The Black Creek Project, a 12,000 acre watershed program in Allen County, Indiana was initiated in 1972. It was a demonstration project, supported by detailed research, aimed at understanding agricultural land-use impacts on water quality in the Maumee River basin. This effort preceeded the work of PLUARG and the IJC recommendations, but provided a foundation for additional agricultural non-point source work through Conservation Districts and USDA supporting agencies. With leadership from the Allen County Soil Conservation District, the Black Creek 108 project focused on cropland erosion, streambank erosion, and movements of sediments and nutrients through the watershed. Research conclusions of the 5 year project were: (1) Many agricultural pollutants can be controlled by sediment control; (2) Raindrop impact is the major factor on soil detachment; (3) Many water quality improvements can be made by treating critical areas; and (4) Streambank erosion accounts for less than 10 percent of the sediment load.

In July, 1980, the Defiance and Allen SWCDs in Ohio submitted a joint proposal - The Maumee River Basin Water Quality Demonstration Proposal. This proposal was built on the strength of the PLUARG findings, the Black Creek project, the LEWMS data, and the Honey Creek project. The Allen and Defiance proposal includes a strong conservation tillage component, but there are distinct differences in the two components. The Allen SWCD component includes the Allen County Conservation Tillage Demonstration and an Allen County Rural Sewage Demonstration. The conservation tillage component is built on the strength of providing special technical assistance, providing tillage equipment, conducting demonstration plots, and a strong educational program with deliberate efforts to avoid cost-share incentive programs.

The Defiance SWCD project has been titled the Defiance-Lost Creek Demonstration Project. Major focus of this project is: promotion of conservation tillage systems; development of new and innovative practices for the flatter, heavy clay content soils; field-size water quality monitoring plots to measure impacts of different tillage systems on the high clay soils; and maximum accelerated BMP application on the 2,500 acre Lost Creek watershed. Special educational and technical assistance manpower is supported by the 108 fundings. A local task force of agency representatives and farmers has been developed for planning and implementing inputs. Both the Allen and Defiance projects are funded for long-term implementation through 1984.

U.S. Army Corps of Engineers projects in the basin are the Cuyahoga River Restoration Study and the Black River Study in Ohio. The Cuyahoga Study is a special upland erosion and streambank erosion study undertaken by the Corps to determine the source of harbor dredge sediments in the Cleveland harbor at the mouth of the Cuyahoga River. It was previously determined from harbor dredge records and monitoring data from the river that 80 percent of the harbor sediments were coming from approximately 303 square miles (195,000 acres) between Independence and Old Portage, Ohio. The intent of the study is to assess sources of sediments and the possible remedial measures. Preliminary data suggests major sediment contributions are derived from upland watershed erosion. Remedial measures will be left to local municipal authorities, soil and water conservation districts, and other agencies with appropriate legislative authority.

The Black River Study parallels efforts of the Cuyahoga Study, but is in the very early stages. Major emphasis will be directed to upland watershed erosion, streambank erosion assessments, and development of a remedial measures program. Excess sediment loads and expensive harbor dredge disposal costs are major reasons for the study effort. It is expected that a land treatment watershed management program will be recommended for the Black River.

ACP Special Water Quality Projects. Agricultural Stabilization and Conservation Service (ASCS) funds are also being used in implementing programs in the Lake Erie basin. A Honey Creek ACP Special Water Quality

Report was approved in 1979 to complement the Honey Creek Watershed Management Project. The ACP special funds were used for cost-share incentives with landowners and operators in Honey Creek. Major BMPs included conservation tillage, cover crops, and structural measures such as grassed waterways, chutes or structures, and animal waste management systems.

In Indiana the Allen County ACP Special Water Quality Project has taken a very unique approach. Special efforts to provide water quality and land treatment focuses on small watersheds (1200 to 2400 acres), generally within a major drainage area. Priority watersheds within the county were identified using the "ANSWERS" computer model developed in the Black Creek study. Major sediment sources and erosion problems were identified for the 13 priority watersheds. Follow-up inquiries were directed towards these priority areas. Ultimately, groups of local landowners and farm operators worked together to develop watershed land treatment plans. A systematic sequence for BMP installation was developed and construction initiated. Major practices include: grassed waterways, chutes, drop structures, terraces, debris basins, and streambank protection.

The joint U.S./Canadian effort demonstrates that local implementation is possible, existing agencies can do the job, and that local-level demonstration projects can be implemented. Additionally, these on-going projects illustrate that with adequate funding, manpower support, and local information-education programs, the PLUARG-IJC recommendations can be successfully implemented.

NORTHEASTERN STATES WASTE TREATMENT LAGOON EVALUATION

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In 1978, the Soil Conservation Service (SCS) undertook a program to evaluate the performance of 20 waste treatment lagoons in six Northeastern States. The purpose of the program was to learn how well SCS design criteria predicted lagoon performance in the colder climatic areas and to determine needed design and management changes.

To obtain a representative cross-section of lagoon operations, the choosen locations included 16 dairy milk centers (milk parlors plus bulk tank rooms), 2 swine operations, a veal operation and a slaughtering plant. Examples of lagoons designed for aerobic and anaerobic operations were included. Also considered in the selection of the sites were their locations with respect to climatic regions. The lagoons chosen for review were as follows:

State	Climatic Region	Type of Farm	Type of Lagoon
VT	Cold, Humid	Dairy	aerobic
		Dairy	aerobic
		Dairy	aerobic
		Veal	aerobic
NY	Cool, Humid	Dairy	aerobic
		Dairy	aerobic
		Dairy	aerobic
VA	Warm, Humid	Dairy	aerobic/anaerobic
		Swine	anaerobic
		Dairy	anaerobic
CT	Cool, Humid	Dairy	aerobic
		Dairy	aerobic
		Dairy	aerobic
WV	Cool, Humid	Dairy	aerobic
	Warm, Humid	Slaughter	aerobic
	Cool, Humid	Dairy	aerobic
PA	Cool, Humid	Dairy	aerobic
		Dairy	aerobic
		Dairy	aerobic
MD	Warm, Humid	Swine	anaerobic

Samples were taken monthly of the lagoon inflow, contents, and outflow. Each sample was tested in the laboratory for five day biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), total solids, suspended solids, volatile solids, ammonia, nitrate, and total nitrogen, orthophosphate and total phosphorus, chlorides, and fecal coliform and fecal streptococcus bacteria. Onsite tests were made for pH, temperature, specific conductance, dissolved oxygen, lagoon depth, and inflow and outflow rates. The accumulated sludge depth was measured at the beginning and end of the 12-month period. However, in a few cases it was measured monthly. Sludge was sampled and tested for BOD_5, COD, total nitrogen, and total phosphorus.

Groundwater monitoring wells were installed at the Maryland site. The wells were sampled on the same schedule as the lagoon. The samples were tested in the laboratory for chloride, nitrate, ammonia, orthophosphate and fecal coliform.

Diary Operations

An analysis of the data from 12 of the dairy operations showed that inflow rates varied and depended on the manner in which clean-up was performed in the parlors, i.e. solids removal prior to wash-down, the size of the parlor floor, and the length of the milk transfer lines. Daily inflow volumes are shown in the following table:

Daily Inflow Volume, Cubic Meters/Day (gal/day)

Site No.	Vermont	Connecticut	New York	Pennsylvania
1	1.5 (396)	1.1 (286)	1.7 (458)	1.5 (390)
2	1.9 (492)	1.5 (386)	1.0 (272)	2.1 (553)
3	1.8 (476)	0.97 (256)	1.2 (329)	1.2 (310)

The chemical data from the 12 dairy operations indicated that inflow is highly variable. However, lagoon contents showed surprising chemical stability and good removal characteristics.

Biochemical Oxygen Demand (BOD_5)

The inflow BOD indicates the wide variability of values (Figure 1). The difficulty in obtaining a representative composite sample has a definite bearing on the results. The inflow included wash-down water from several types of milk parlors and from milk lines and bulk tanks. At two of the New York sites and one of the Vermont sites, the lagoon inflow systems have settling tanks that retain the heavier solids. The results were also influenced by detergents and sanitizers used in the milk lines and tanks.

Although the variability of the inflow clouded the accuracy of the test results, the lagoon contents data show that the lagoons act as excellent buffering systems. While the inflow exhibited extreme loading conditions

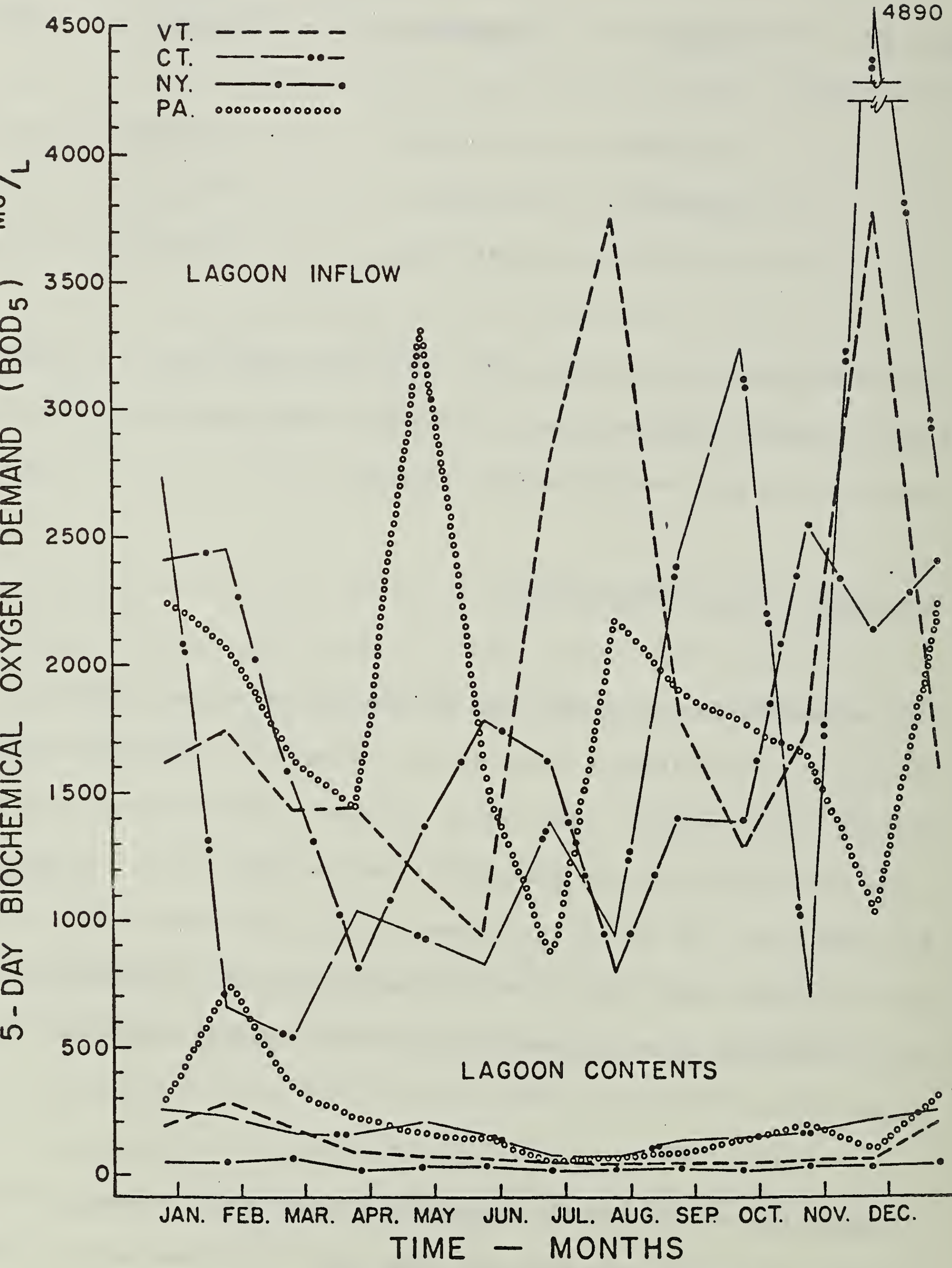

FIGURE 1 : BOD ON A MONTHLY BASIS

that make analysis difficult, the lagoon contents on all sites reflected a reasonably constant BOD value, occasionally meeting State standards for secondary treatment.

The reduction of BOD can reasonably be predicted to equal or exceed 90 percent (Connecticut 91%, New York 98% and Vermont 95%). Reduction at the Pennsylvania site was 88 percent, but if the February lagoon contents spike is not considered (Figure 1) the reduction was 91 percent.

BOD_5 Loading

SCS loading criteria for aerobic lagoons are based primarily on a review of research and the resultant functional success, the success being based mainly on low odor production. The actual loadings determined by this study are shown in the following table. Maximum permissible loadings allowed by the SCS standard are also shown.

Daily Lagoon BOD Loading, Kg/ha (Lb/ac)

State	SCS Standard	Site No. 1	Site No. 2	Site No. 3
Vermont	30.2 (27)	49.3 (44)	19.5 (17)	19.2 (17)
Connecticut	39.2 (35)	19.7 (18)	10.3 (9)	37.9 (34)
New York	31.4 (28)	7.0 (6)	27.7 (25)	20.4 (18)
Pennsylvania	39.2 (35)	38 (34)	82 (73)	35 (31)

Nitrogen and Phosphorus

Often an objective of waste treatment with lagoons is to reduce the concentrations of nitrogen and phosphorus. Figures 2 and 3 indicate the average concentrations of total nitrogen (total Kjeldahl plus nitrate-N) and total phosphorus for both the inflow and contents. The lagoons exhibited a high degree of ability to efficiently reduce concentrations. The reduction in total nitrogen for the States was: Vermont 82 percent, Connecticut 70 percent; New York 93 percent; and Pennsylvania 79 percent. The reduction in total phosphorus for the States was: 47 percent in Vermont, 42 percent in Connecticut, 33 percent in New York, and 30 percent in Pennsylvania. Nitrate-N of the inflow occurred at a very low percentage of the total nitrogen, averaging about 1 percent and less with the exception of the Connecticut sites which averaged 12 percent. Ammonia-N constituted about 75 percent of the total Kjeldahl nitrogen.

Orthophosphate-P was the predominant form of phosphorus in the lagoons. Eighty-two percent of the total P in the Vermont, New York and Pennsylvania lagoons and 70 percent of the Connecticut lagoons were in the ortho form. Inflow ratios (Ortho to TP) varied from a low of 53 percent in Vermont to a high of 70 percent in Pennsylvania.

Groundwater Analysis - Swine Operation

Nineteen groundwater monitoring wells were installed around an anaerobic lagoon in Maryland. The soils at the site are predominately sandy loams which are typical of the eastern shore of Maryland.

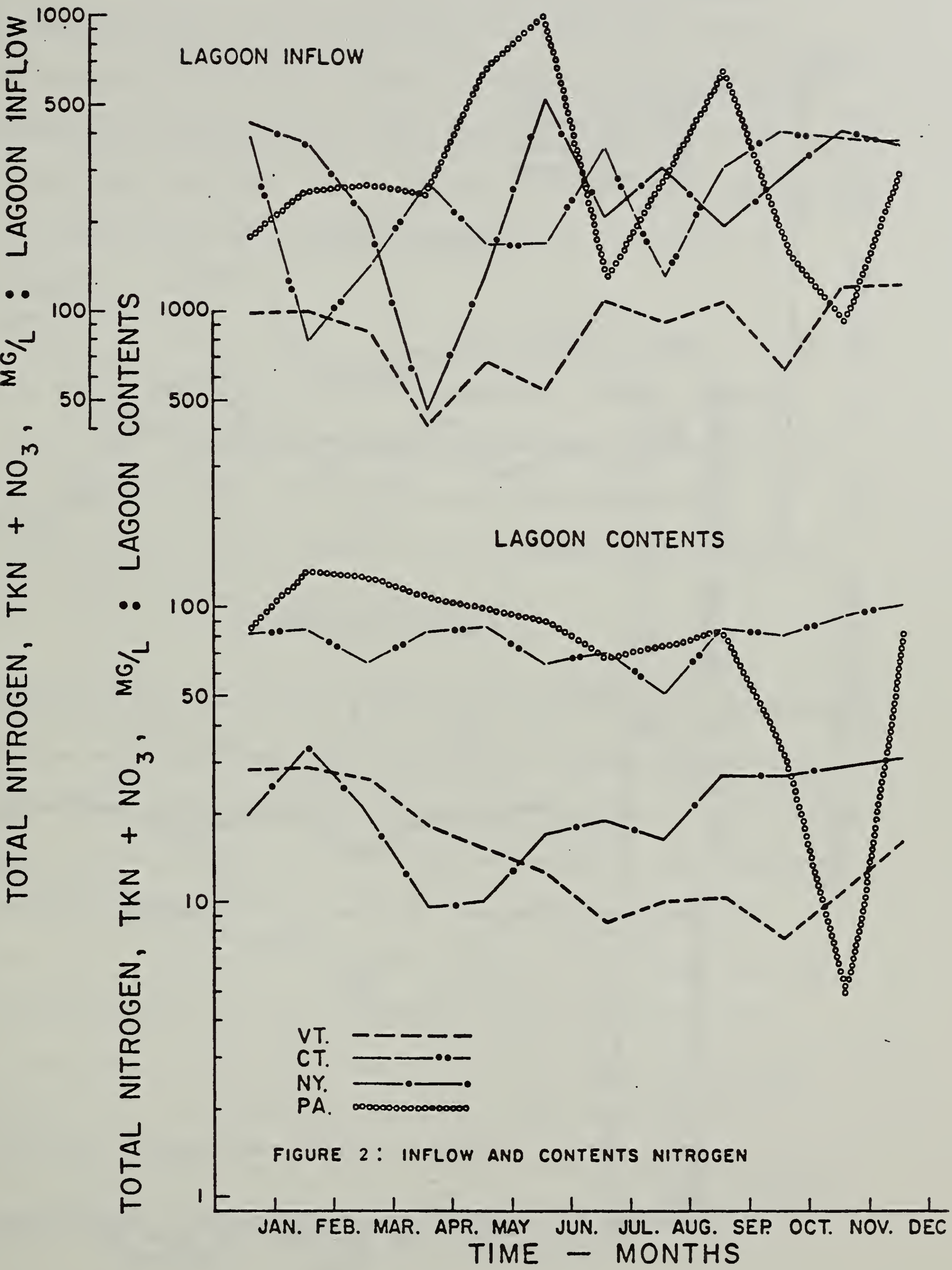

FIGURE 2 : INFLOW AND CONTENTS NITROGEN

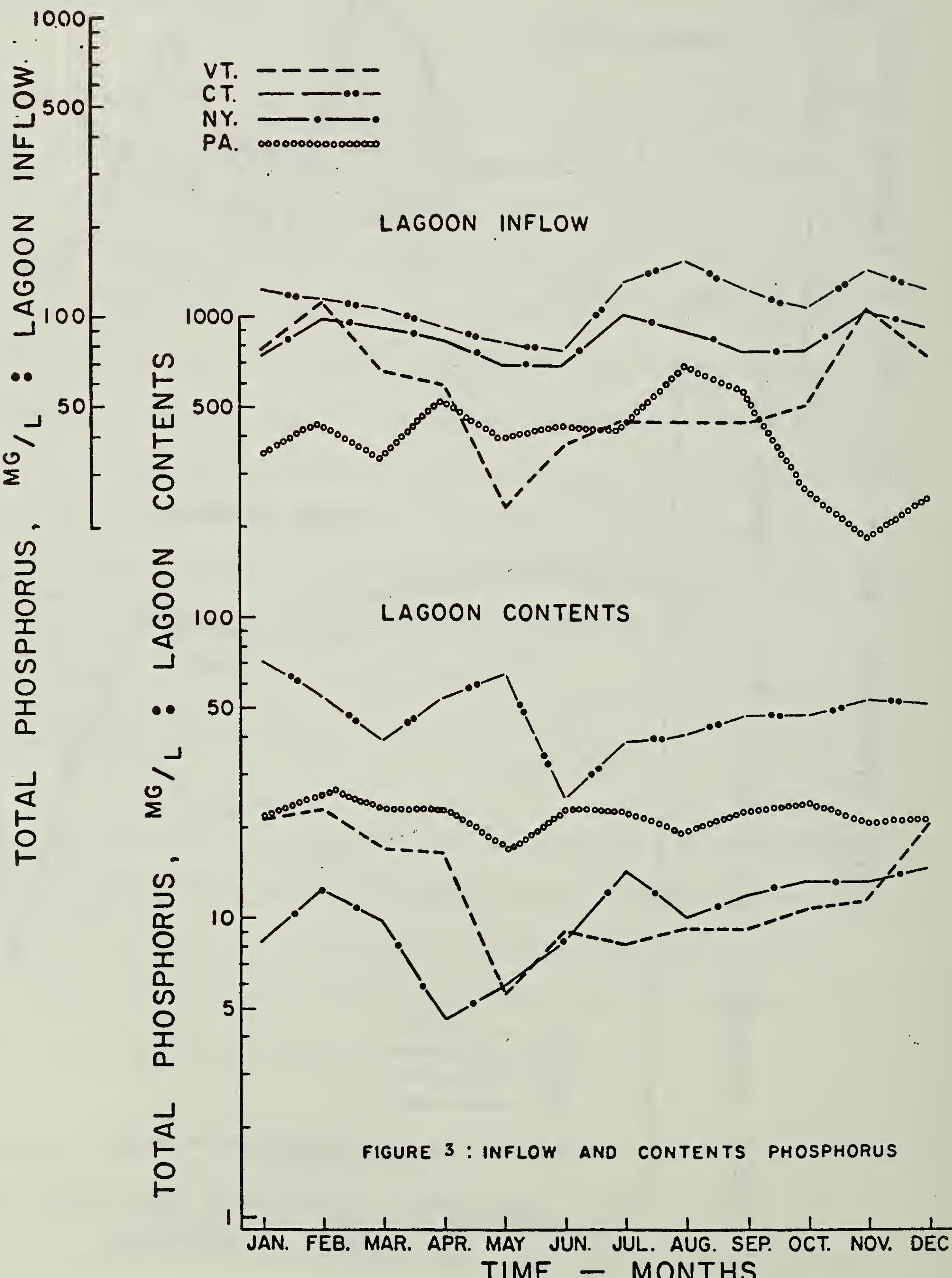

FIGURE 3 : INFLOW AND CONTENTS PHOSPHORUS

Figure 4 shows the location of the wells in relation to the lagoon. With the exception of No. 15, all wells were installed with a bucket auger and cased with 10 cm (4 in) diameter PVC pipe. These well casings were perforated with numerous small drill holes to within 1 m of the ground surface when installed. The bottoms of the casings are unscreened. Well 15 was drilled to a depth of 9.1 m (30 ft) with the bottom 3 m (10 ft) screened.

Sampling of the wells was not preceded by pumping to remove stagnant water. As a result, these analyses must be viewed with caution, as incomplete exchange of water within the casing and groundwater is likely. Furthermore, certain chemical species probably are affected by exposure to and/or exchange with air in the wells.

Additionally, the owner maintained a small herd of cattle and intermittently, some waterfowl were within the lagoon enclosure in direct contact with the wells. In addition, periodic application of chicken manure as a fertilizer was used to stimulate growth of grass. The data supports the conclusion that substantial contamination of many of these wells resulted from these practices. In particular, unusually high values of fecal coliform, ammonia-N and phosphate, encountered in wells some distance from the lagoon as compared to results for wells close to the lagoon, suggested contamination. It is suspected that these and other constituents infiltrated into the soil during rainy periods and following the spring thaw, and were able to migrate along well casings and contaminate some wells.

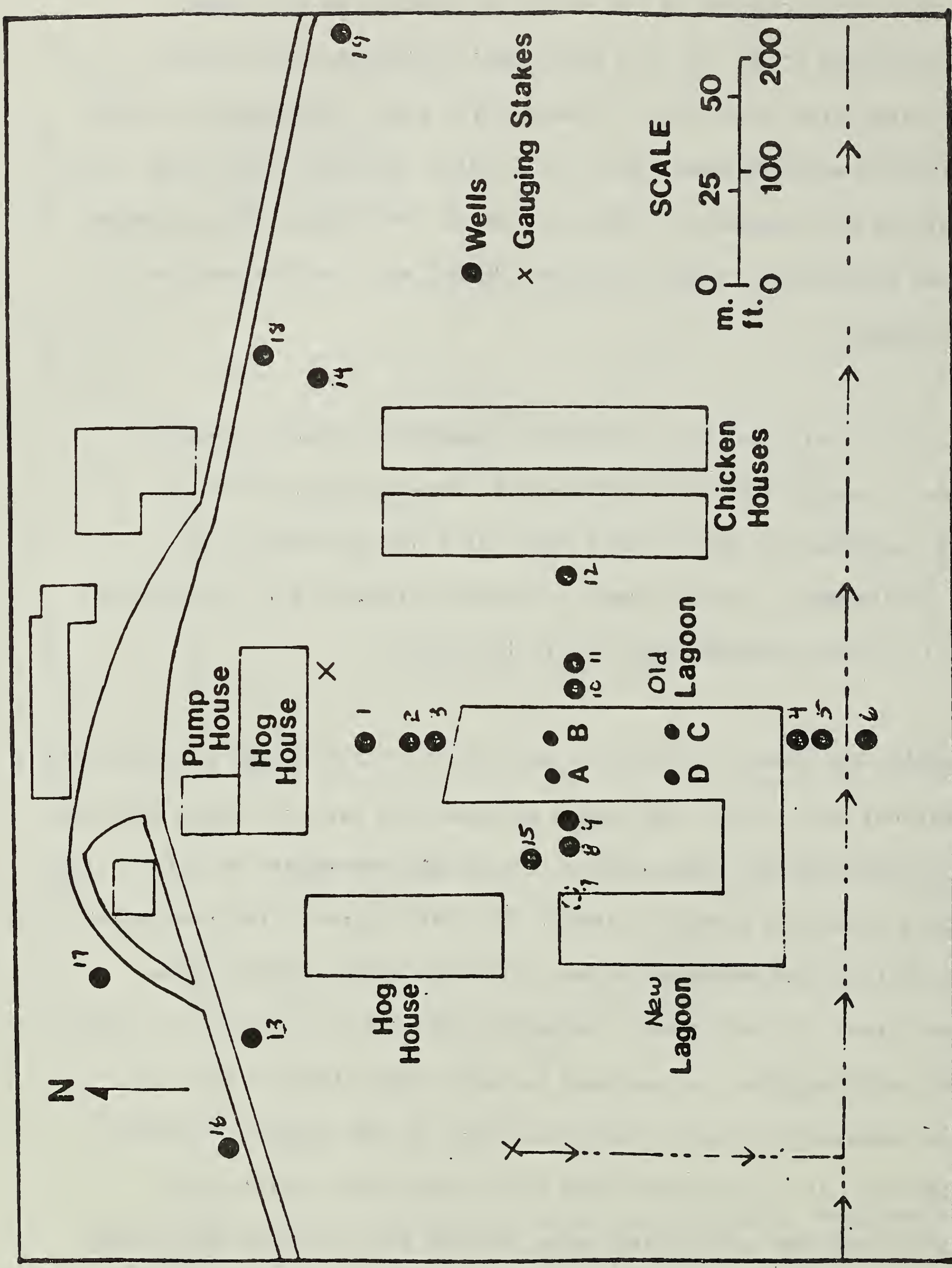
N
Pump House
Hog House
Hog House
Chicken Houses
Old Lagoon
New Lagoon
Wells
x Gauging Stakes
SCALE
m. 0 25 50
ft. 0 100 200
A
B
C
D
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19

Figure 4

Evidence of this type of contamination was not readily apparent for the chloride data. Examination of Cl results for each month demonstrated a steady decline in Cl away from the lagoon. However, the wells close to the lagoon (3, 4, 9, 10) had Cl values in excess of 100 mg/l. The lagoon itself exceeded this level only once. Surface contamination elevated the Cl levels observed but did not destroy the anticipated decrease of this parameter away from the lagoon. Although contamination undoubtedly affected Cl levels around the lagoon, the concentration of this species is naturally elevated, such that an increment of contamination to some wells will not destroy the overall trend but merely perturb it somewhat.

In the case of coliform bacteria, ammonia and phosphate contamination can be recognized easily because these constituents are normally very low in groundwater due to adsorption on soil particles or mechanical filtration. Even modest contamination from surface sources is readily apparent and will destroy any underlying geographic trends around the lagoon.

Conclusions-(not all conclusions are supported by information in the preceding sections) SCS design criteria conservatively predict the lagoon sizes needed in the Northeastern United States to effectively reduce BOD loads. Bacterial activity during the winter months is at a low level, but due to conservative design values, the startup activity in the spring is rapid enough to re-establish aerobic conditions so that odors are minimal.

Loading criteria can be made more conservative so that lagoon contents discharged into streams could be permissible under EPA and regulations of some States where BOD and suspended solids are the parameters of concern. However, effluent application on agricultural land will continue to be the wastewater utilization process encouraged by SCS.

The lagoon management guidance that emerges from this study indicates that: (1) although significant wastewater treatment does occur in the lagoons with minimum odor, they could be considered as storage ponds for subsequent land application of the contents; (2) biomass production is stimulated to convert nutrients to organic form; (3) lagoon contents should be pumped out when BOD and suspended solids are low; and (4) sludges contain high levels of nutrients. Consequently, where additional nutrients are desired on the land, the sludges can be used as a source of those nutrients.

Chlorides apparently do not impair bacterial activity in the 12 milk center lagoons. The literature reports that chlorides increase with time more seriously in arid climates than in the humid east. A regression analysis of chlorides and specific conductance could be a useful tool to check for chloride buildup in the future.

The groundwater monitoring program showed that out-migration of pollutants does occur and will continue to occur over a period of time even when sites are considered to be sealed. Care should be exercised in site selection and treatment.

WATER QUALITY IMPROVEMENTS ON THE LQ DRAIN

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SETTING

LQ Drain is located in Twin Falls County west of Twin Falls, Idaho. The surrounding area is commonly referred to as Magic Valley. LQ Drain is a natural tributary to the Snake River and is used primarily for irrigation return flows by the Twin Falls Canal Company.

Soils are predominately a Portneuf silt loam with slopes of 0-6 percent. Soils are deep and well drained, formed in deep loess. The top 40 inches are a silt loam containing less than 18 percent clays (generally 6-13 percent) and less than 15 percent particles coarser than very fine sand. Organic matter in the upper 15 inches of the soil profile averages from 1-2.5 percent. Permeability is moderately slow as a result of a discontinious weakly cemented calcic layer.

Climate in the LQ Drain area is typical of the surrounding area at an elevation of 3800 ft. MSL, and is considered to be dry and temperate. Average annual precipitation at Twin Falls is nine inches. Mean maximum July temperature at Twin Falls is 91°F (33°C) and mean minimum January temperature is 45°F (7.5°C). Growing season averages 133 days.

Twenty-five farm units are contained in the 3700 acre watershed. Primary income is from cash crop operations; however, several units include dairy or beef cattle.

Water quality pollutants resulting from irrigation return flows have long been a recognized problem in the main stem and tributaries of the Snake River in Idaho. These pollutants primarily consist of sediment in the surface runoff from irrigated fields, and to a lesser extent the nutrients, pesticides and other pollutants identified with sediments. In the LQ watershed, sediments and associated nutrients contained in drain runoff were among the highest per acre of any in the Twin Falls area (3.0 tons/acre).

Most sediments in irrigation return flows originate or result from the irrigation of sloping lands by the furrow method (1). Factors which may affect erosion and subsequent sediment losses are land slope, soil texture and depth, crop cover, furrow stream size, and irrigation management practices. Changing one or more of these factors slightly can cause an appreciable change in erosion rates.

The focus of the LQ Drain project was to demonstrate the sediment removal efficiencies of alternative practices (BMPs). The effectiveness of modifying the irrigation system or irrigation management to reduce erosion and resulting sedimentation was recognized,but was not a part of this study.

THE STUDY

A cooperative irrigation return flow study was begun in December 1976. Cooperating groups consisted of the University of Idaho Research and Extension Center, USDA Science and Education Administration - Agricultural Research (now Agricultural Research Service), and the Snake River Soil Conservation District. The study was partially funded by the Environmental Protection Agency through funds set aside for Section 208 activities under P.L. 92-500.

The objectives of the study of primary interest to SCS were to:

1. Evaluate the effectiveness of alternative Best Management Practices (BMP's) at reducing sediment loads from irrigation return flows.

2. Develop resource management systems for sediment and nutrient control for inclusion in Section 208 plans.

PROCEDURE

Overall procedure centered on monitoring the LQ Drain during 1977, installing a series of BMP's before the 1978 irrigation season, then measuring impacts during 1978. A series of models were developed as a part of the study effort, but their functions and capabilities will not be discussed here.

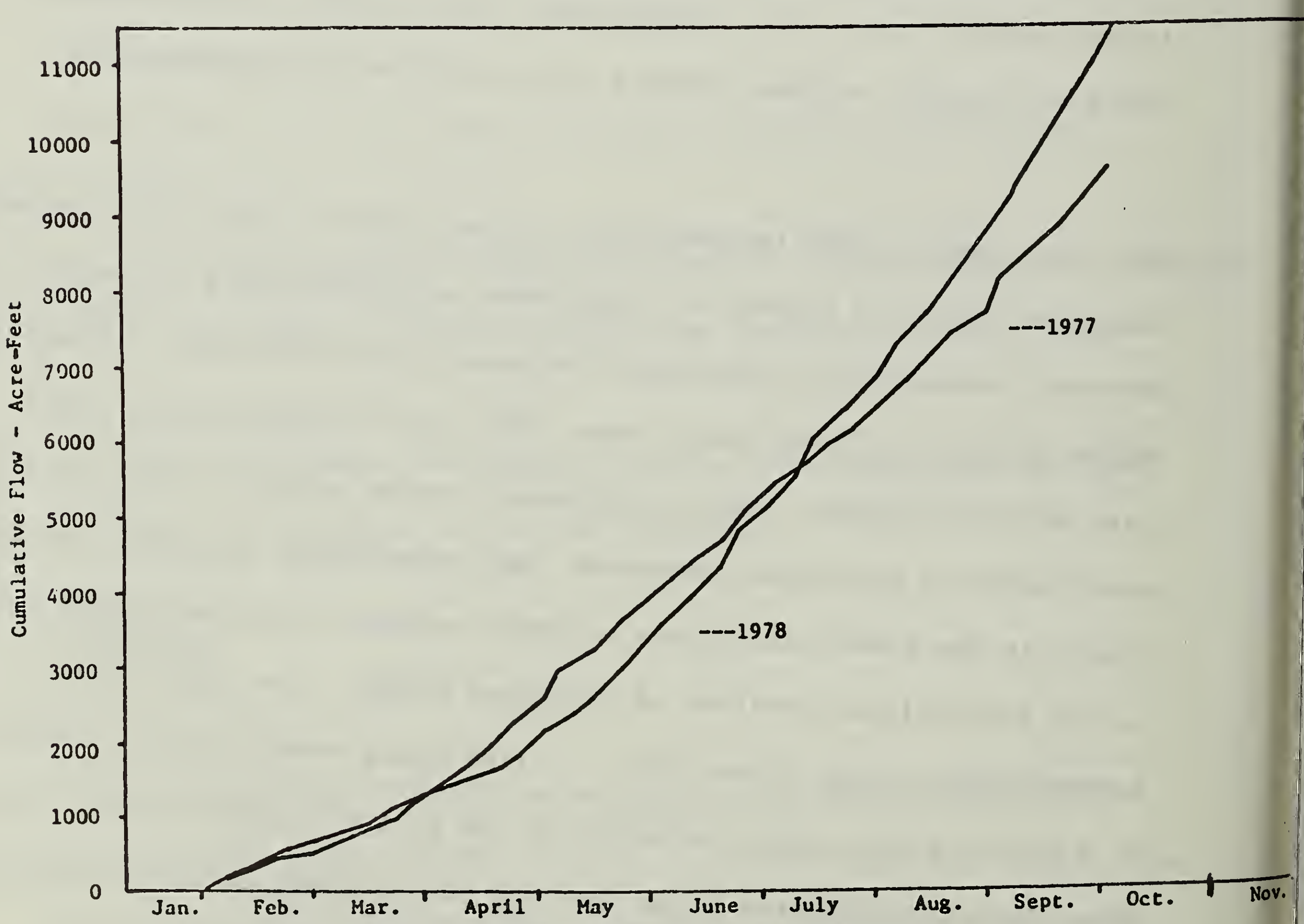
Monitoring of the LQ Drain consisted of five primary sampling stations on the main drainage and a large trapizoidal flume at the canyon rim for flow measurement. Samples were taken and analyzed every two weeks. Sampled parameters included temperature, electrical conductivity, pH, COD, dissolved oxygen, total phosphate, total nitrogen, and suspended sediments. COD did not appear to be an important parameter in the study, so that analysis was discontinued.

During the 1977 irrigation season, sediment runoff determinations were made for various crops grown in the LQ Drain Watershed. Crops evaluated include grain, beans, corn, sugar beets, and alfalfa. Determinations were based on frequent sediment samples and continuous flow measurements.

The exact level of BMP implementation between the 1977 and 1978 irrigation season is not known because of independent activities by a few owner-operators. Measured implementation includes 9 sediment basins, 6360 feet of vegetated buffer strips, 20 T-slot structures, 2096 feet of buried drain runoff control pipe with mini-basins, and one tailwater control system. Installation costs were funded by individual operators, the conservation district, and SEA-AR. T-slot is the common name given to small sediment retention basins excavated in the drain ditch downslope of irrigated fields. The top of the T is perpendicular to the drain ditch. Buried drain runoff control systems consist of a buried plastic pipe installed at the foot of fields eroded from runoff. Riser inlets are located along the pipe with earthen or earthen and strawbale checks immediately downslope to form a small sediment basin.

RESULTS

Total measured flow at the flume for February 1-September 30, 1978 was 11,000 acre-feet as compared to 9,900 acre-feet for the same period in 1977 (Figure 1). Early season flows were higher in 1977 due to the need to replenish low soil moisture.



Cumulative Flow - LQ Drain Flume - 1977 and 1978.(2)

Figure 1

Total sediment yield at the flume for February 1-September 30, 1977, was measured at 9600 tons or 2.6 tons/acre. For the same period in 1978, the sediment yield was 3800 tons or 1.0 tons/acre. From another perspective, average seasonal sediment concentrations were reduced from 685 ppm in 1977 to 250 ppm in 1978. The values represent a 60 percent sediment yeild reduction for the watershed based on 1977 measurements, and a 66 percent reduction based on earlier baseline conditions established by SEA-AR. The general pattern of sediment yield in 1978 was similar to that in 1977, only at a lesser rate. (Figure 2).

The pattern of peak concentration of total phosphate during 1977 and 1978 were similar with marked reductions in peaks for 1978. (Figure 3).

Individual BMP's were quite effective in reducing sediment loads (Table 1). Sediment removal efficiencies varied considerably from site to site and generally are directly correlated to sediment concentrations. In some instances the T-slots were installed in drain ditches common to several farms causing some variation in sediment concentrations unrelated to onfarm conditions being measured.

Table 1. Average Seasonal Sediment Removal Efficiencies for BMP's, LQ Drain Study, 1977-1978

BMP	Sediment Removal Efficiency
Sediment Basin (Malone Farm)	92%
T-Slot (Crawford Farm)	74%
Vegetative Buffer Strip	75%
Buried Drain Runoff Control System	80%

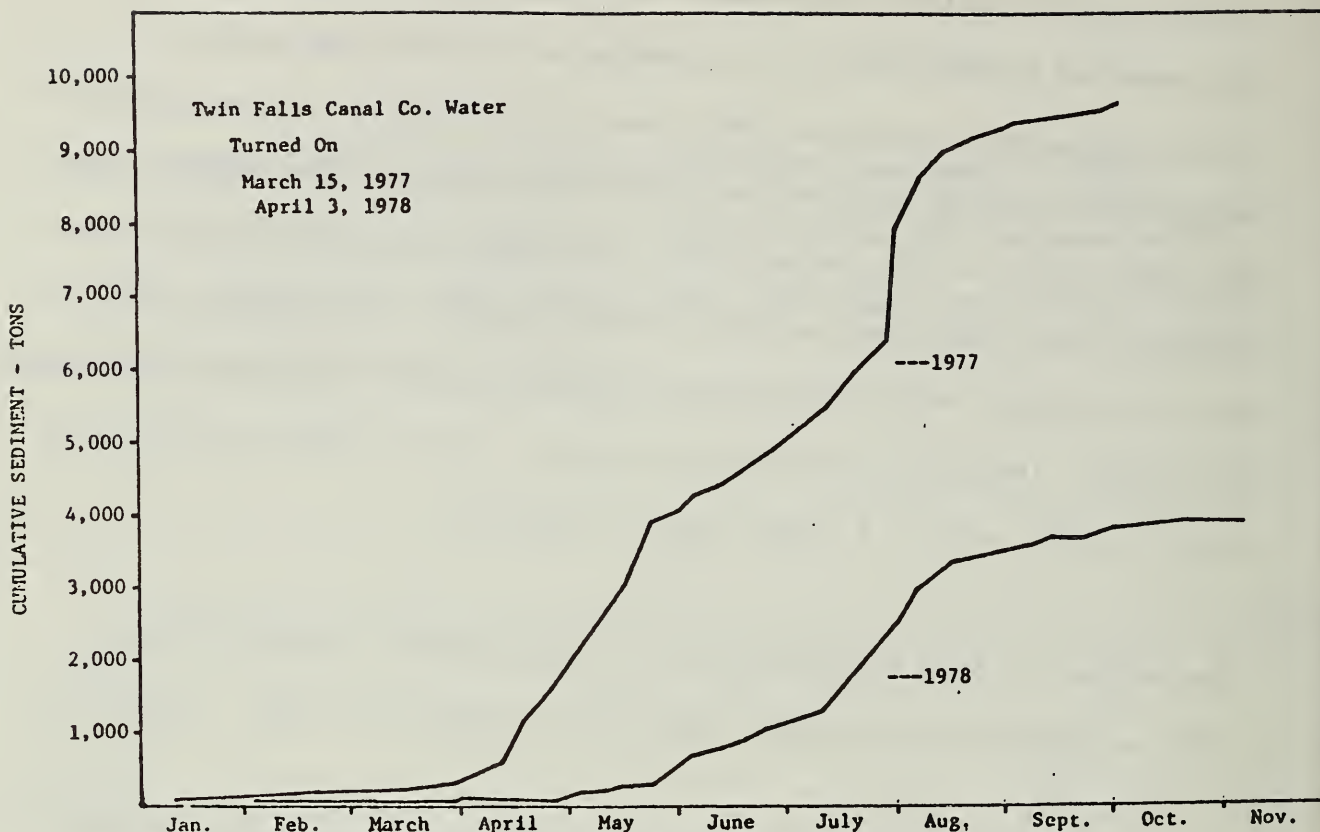


Figure 2. Cumulative sediment - LQ Drain Flume - 1977 and 1978. (2)

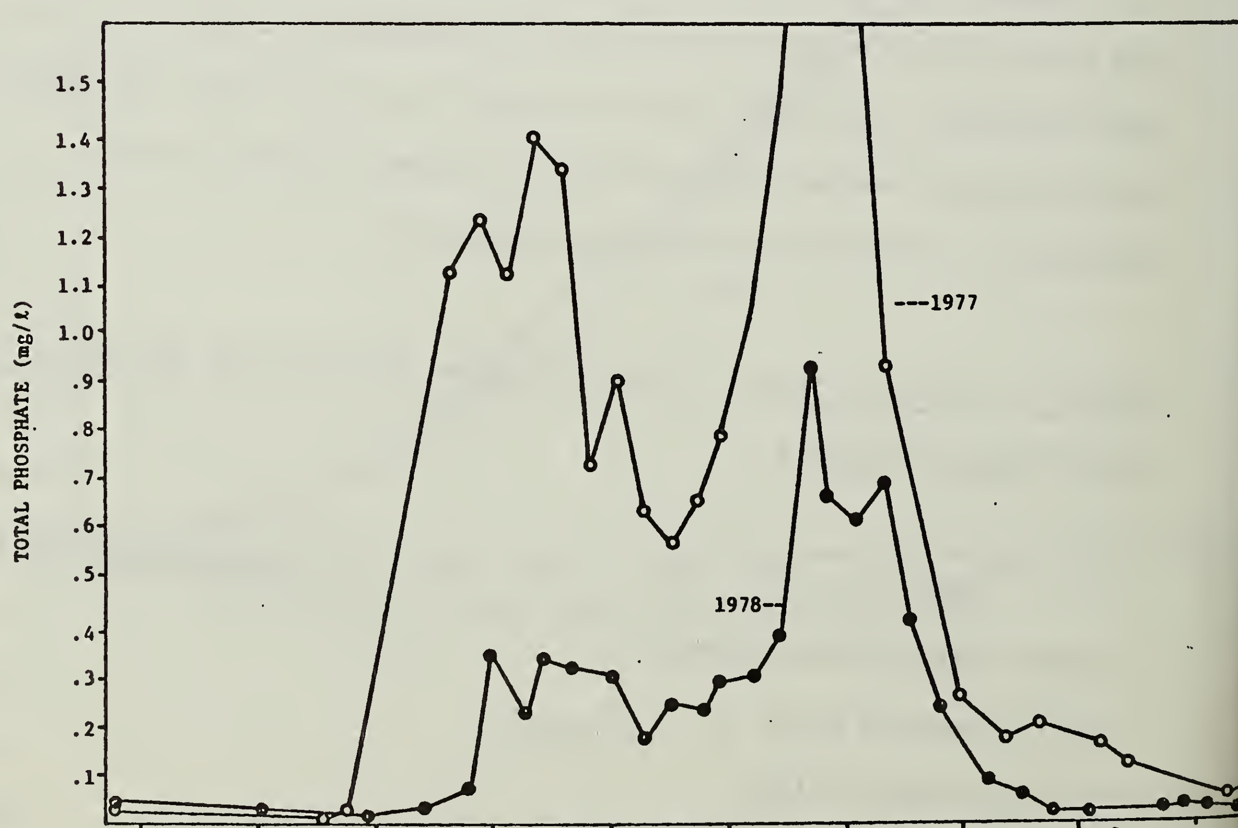


Figure 3. Total phosphate in irrigation return flow - LQ Drain Flume. 1977 and 1978. (3)

SUMMARY

The LQ Drain study showed BMP's can effectively remove sediments and associated pollutants from irrigation return flows, thus improving water quality. Practices such as vegetated buffer strips can be implemented during normal field operations. Others, such as sediment basins and T-Slots, will require specific construction techniques and considerable management to maintain their design capabities and effectiveness. Buried drain runoff control systems offer the advantage of ease of modification during the operation phase (height of risers can be increased as sediment deposits increase at the ends of fields).

The LQ Drain Study did not evaluate the effectiveness of BMP's that modify the irrigation system or system management. As stated in the introductory remarks, minor changes in some aspects of the physical system or management can be translated into large reductions in sediment loss.

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HIGHLIGHTS OF STUDIES ASSESSING THE INFLUENCE OF FLOOD CONTROL IMPOUNDMENTS ON WATER QUALITY

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During the past five years the Soil Conservation Service (SCS) in Alabama has been conducting studies to assess the effects of flood control impoundments on water quality, including the effects on aquatic life. Some aspects of the studies were conducted under cooperative agreements with Auburn University and some were conducted by SCS specialists working either independently or in cooperation with personnel of the U.S. Forest Service and the State of Alabama. During 1980 the results of the studies were published in three reports (Lawrence and Webber, 1980; Kelly et. al., 1980; and Payne and Kelly, 1980).

The overall objective of the studies was to compare the impact on water quality of dams having surface-water releases with those having cool-water releases. In Alabama there are more than 80 structures which discharge only surface waters from the reservoirs, but there are only two which release normal flows from the cooler bottom waters. The original purpose of the cool-water release was to provide downstream water temperatures comparable to those in the natural stream prior to construction and to help maintain good habitat for aquatic life.

The two special structures are located on upland streams which are habitat for the redeye bass, a fish species previously thought to be sensitive to too-warm water. Although the redeye is not rare or endangered, it is unique to upland streams of Alabama, Georgia, North Carolina, South Carolina, and Tennessee (Ramsey, 1973).

The studies examined various chemical, physical, and biological characteristics of the waters upstream and downstream of several impoundments, in two natural streams, and in five reservoirs. Fish populations were evaluated upstream and downstream of five impoundments, including the two with cool-water releases, and in one undisturbed stream. A variety of chemical and physical paramters were evaluated including temperature, dissolved oxygen, alkalinity, pH, iron, manganese, nitrogen, phosphorus, suspended solids, and others. Major emphasis of the physical-chemical studies was on temperature and dissolved oxygen.

Macroinvertebrate sampling was conducted upstream and downstream of one impoundment having a surface-water release and on an adjacent natural stream. Table 1 summarizes the types of studies made in the various watersheds.

Table 1. Locations of streams and impoundments studied in Alabama and types of analyses conducted.

			Type analysis			
Watershed	Site no.	Cool-water release	Fish populations	Biological parameters*	Water quality in reservoir	Water quality in stream
Choccolocco	7	X	X		X	X
Choccolocco	24	X	X		X	X
Tallaseehatchee	3		X		X	X
Cheaha	6		X		X	X
Terrapin	31				X	X
Crooked Creek	16		X	X		X
Crooked Creek	**		X	X		X
Choccolocco	**					X

* Phytoplankton, zooplankton, macroinvertebrates
** Natural stream having no impoundment.

Results

The studies revealed that fish populations in upland streams are altered as a result of impoundments placed on the streams. This is true regardless of whether water is released from the surface or the bottom of the impoundement. However, the shifts are not necessarily detrimental. For example, in the Crooked Creek Watershed 26 species of fish were collected immediately down-stream of an impoundment having a surface release, while 13 species were collected upstream. On a nearby undisturbed stream 17 species were collected at a site having similar physical characteristics (i.e., average flow, depth) as the site downstream of the dam. In this particular watershed, redeye bass were collected at all sites, but their numbers were less downstream of the dam. There were fewer minnows downstream, but many more blacktail redhorse, a species of sucker. The number of bluegill also increased dramatically at the downstream site. In general, the number of fish decreased somewhat immediately downstream, but the biomass (weight per acre) increased considerably. Table 2 reflects the findings for five sampling stations during 1979, the last year of sampling in this watershed.

Studies in the Choccolocco Creek Watershed allowed for a comparison of fish populations before and after construction of two structures with cool-water releases (Sites 7 and 24). Data for samples collected by the State of Alabama between 1966 and 1968 construction and betwen 1974 and 1976 after construction were used to compare with fish population studies made by SCS and cooperating agencies in 1978.

Table 2. Data on fish and macroinvertebrate populations and on physical characteristics of five sampling stations for the Crooked Creek Watershed, Alabama, 1979.

	Upstream of dam	Downstream of dam		Undisturbed stream	
		0.8 mi.	1.4 mi.	upstream	downstream
Station No.	1	T	2	3	4
Fish					
Number of species	13	26	29	17	28
Number per stream mile 1/	6,494	5,350	9,662	7,691	15,277
Pounds per stream mile 1/	143	289	225	141	165
Macroinvetebrates					
Number of taxa	52	59	52	49	59
Number of individuals	1,279	5,205	1,663	1,020	1,679
Physical Characteristics of each station					
Average flow	17	29	35	29	45
Average depth	0.8	1.0	1.2	0.9	1.6

1/ Extrapolated from data collected at each 300-foot-long sampling station.

These studies reflect some shifts in populations after construction of the dams. The composite population of redeye bass, for example, dropped from 94 per acre during the 1966-68 sampling period to only 40 shortly after construction; however, the number collected in 1978 was 135 per acre. Sampling in 1978 showed considerable increases in biomass of the redeye bass, bluegill, longear sunfish, and several other species. Five species that were in scant supply during the 1966-68 period were absent during 1978; these include three species of shiner, the bigeye chub, and the speckled darter. The composite shifts in biomass for Shoal Creek, the stream having the two structures with cool-water releases, are illustrated in Figure 1.

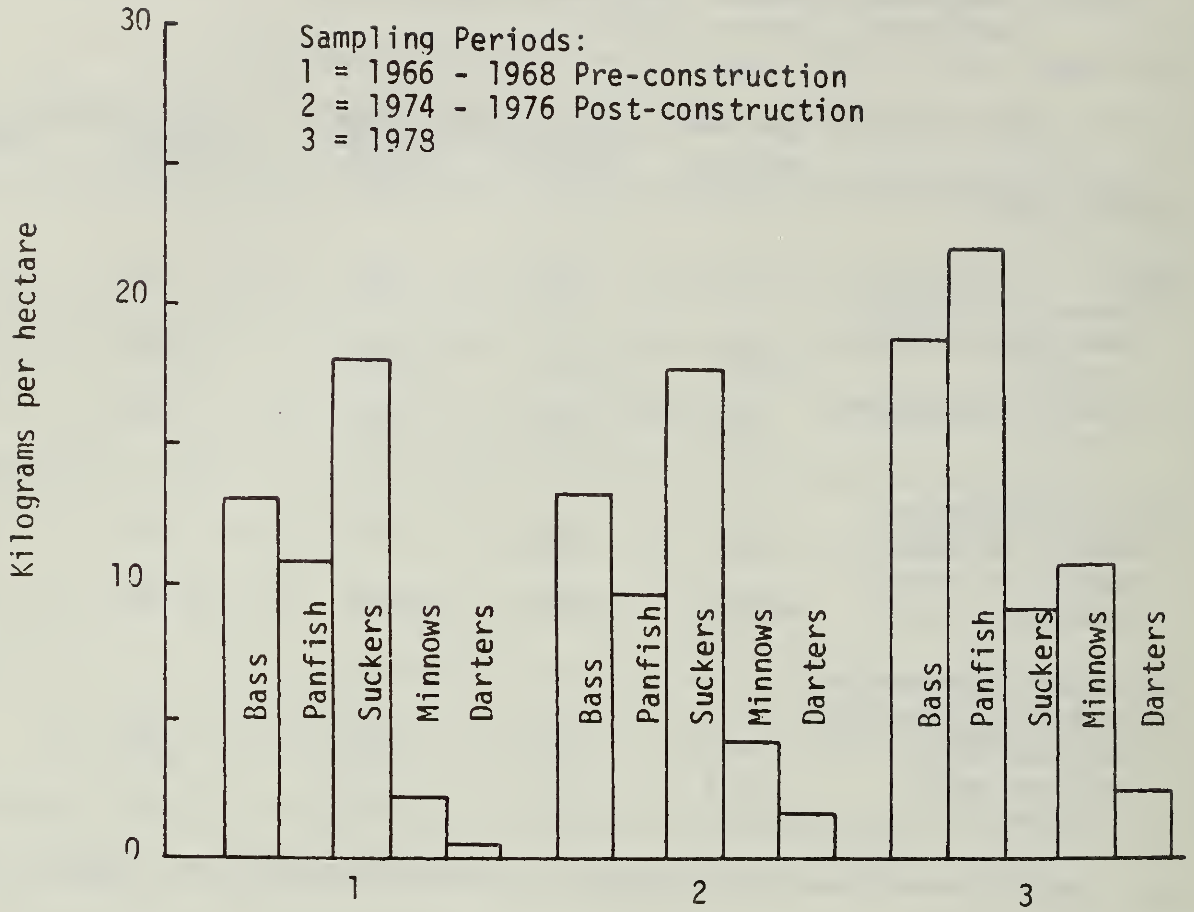

Figure 1. Composite biomasses for selected groups of fishes in Shoal Creek, collected before and after construction of two dams with cool-water releases; Choccolocco Creek Watershed, Alabama (Kelly et al, 1980).

No data on macroinvertebrates are available for the stream on which the two cool-water release structures are located. However, the study in the Crooked Creek Watershed reflects a substantial increase in the total number of macroinvertebrates collected downstream of a dam with surface release. The number of taxa collected at the downstream station were only slightly higher than either that of the upstream or that of the comparable station (No. 3) on the adjacent, undisturbed stream (see Table 2).

Physiochemical studies were conducted in five watersheds. Water samples were collected at stations upstream and downstream of all impoundments, in two natural streams, and at four points between the surface and bottom of four reservoirs. In two different studies involving physiochemical characteristics of streams and impoundments, a total of 22 parameters were evaluated, excluding flow and temperature. No significant differences were noted between stations located upstream and downstream of any of the impoundments for any of the constituents except iron and manganese. For these two, somewhat higher values were noted downstream of the two impoundments with cool-water releases. However, the values were still low, and based on the fish population studies were certainly not high enough to affect aquatic life.

The manganese concentrations below mid-depth in two reservoirs with surface water releases were 7 to 80 times higher than at comparable depths in the two impoundments with cool-water releases. Similarly, iron concentrations were 3 to 7 times higher at the lower depths in the

surface-release reservoirs than in those with cool-water releases. The highest manganese and iron concentrations were 6.1 mg/L and 11.6 mg/L, respectively. The high concentrations below mid-depth in the impoundments with surface releases are attributed to the low dissolved oxygen concentrations at these depths, a condition which promotes the conversion of insoluble iron and manganese to soluble forms.

One study conducted by Auburn University for SCS suggested that suspended solids were routinely higher downstream of an impoundment having a surface release. With the growth of phytoplankton in the reservoir and their subsequent release downstream, this finding appears logical. However, for three other structures with surface releases, a consistent trend of this sort was not established for suspended solids.

The most significant findings from the physiochemical phase of the studies concerned: (1) the water temperature relationships between stations upstream and downstream of the two types of impoundments; and (2) the dissolved oxygen-temperature relationships in impoundments with and without cool-water releases. Using continuous recording thermographs, SCS personnel determined that average daily high temperatures of water discharge from impoundments with cool-water releases are about 1.5 to 5.0°C (2.7 to 9.0°F) cooler than those from structures releasing only surface waters. The average daily low temperatures were 1.3 to 3.6°C (2.3 to 6.5°F) cooler than the discharges from surface-release structures. The differences in water temperature between stations upstream and downstream of the two types of impoundments are shown in Table 3.

Table 3. -- Differences in water temperature between stations upstream and downstream of two impoundments with cool-water releases and two with surface-water releases during Summer, 1978.

Type of release, name of impoundment and temperature extreme evaluated	Average temperature		
	Downstream	Upstream	Difference
	-------------------°C----------------------		
Cool water release:			
Choccolocco 7			
Average daily high	24.5	20.7	3.8
Average daily low	23.6	18.8	4.8
Choccolocco 24			
Average daily high	23.8	22.5	1.3
Average daily low	23.2	20.5	2.7
Surface water release:			
Cheaha 6			
Average daily high	27.9	22.6	5.3
Average daily low	25.6	21.7	3.9
Tallaseehatchie 3			
Average daily high	31.9	25.8	6.1
Average daily low	28.5	22.2	6.3

Studies of the dissolved oxygen (DO) and temperature profiles in three reservoirs with surface-water releases and two with cool-water releases revealed important differences. Figures 2 and 3 illustrate how DO and temperature varied with depth for the two types of structures. These figures are for only two dates, but they are typical of other profiles established throughout the summer of 1978 for the two types of reservoirs. In all cases, the DO levels decreased rapidly with depth throughout the impoundments having surface-water releases. One to two meters below the surface, DO generally dropped below the desired 5.0 mg/L. On the other hand, DO in impoundments with cool-water releases appeared to be well distributed between the surface and the bottom throughout the summer. The DO dropped below 5.0 mg/L only twice in an impoundment with a cool-water release. At Choccolocco Site 7, DO dropped to 4.5 mg/L one meter from the bottom and 3.2 mg/L at the bottom of August 23. And on September 20, it dropped to 4.5 mg/L at the bottom. In general, the DO distributions were excellent in the impoundments with cool-water releases.

Releasing water from the bottoms of impoundments also has an effect on temperature profiles. The impoundments with cool-water releases exhibited very little thermal stratification at any time between June and September. Weak thermal stratification occurred at Choccolocco Site 7, but this is attributed to the size of the reservoir and its longer detention time. Thermal stratification in impoundments having only surface discharges was always pronounced throughout the summer.

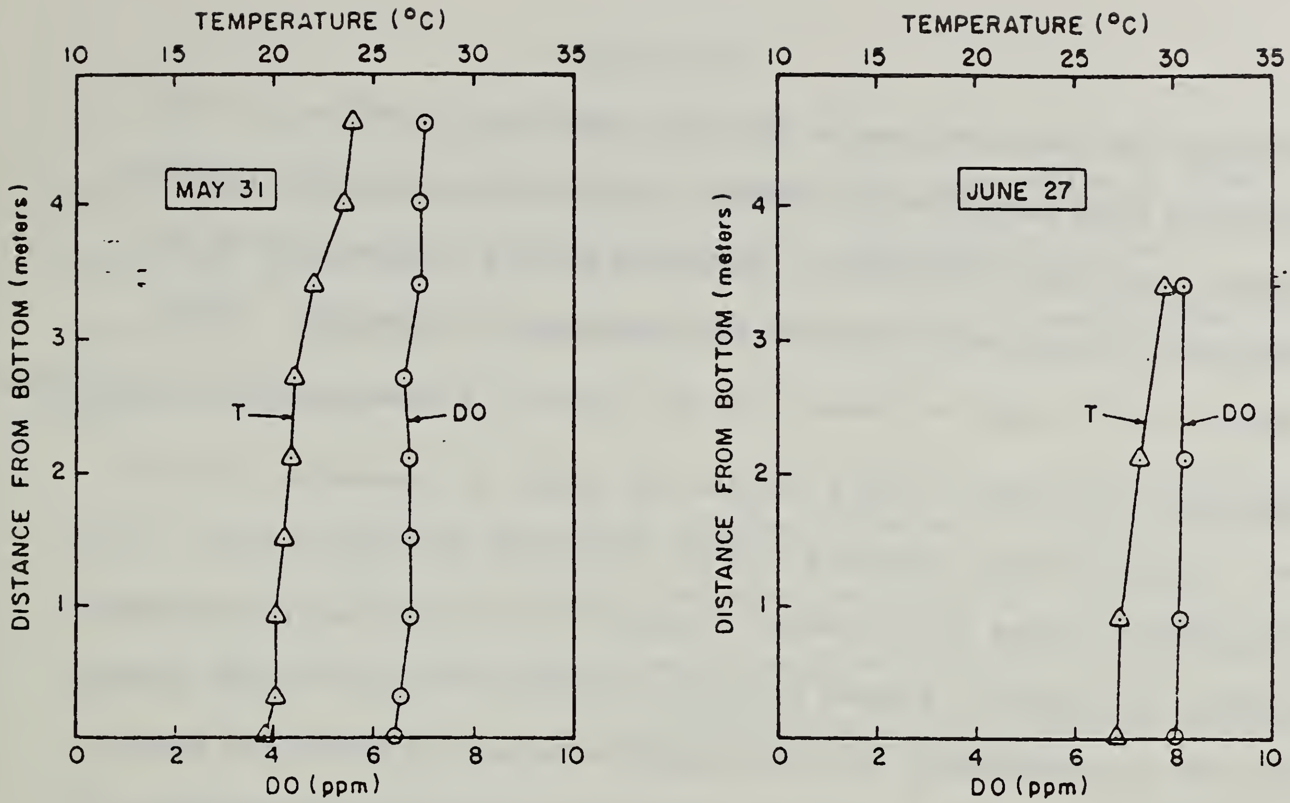

Figure 2. Dissolved oxygen (DO) and temperature (T) versus depth in a reservoir with cool-water release: Site 24, Choccolocco Creek Watershed, 1978.

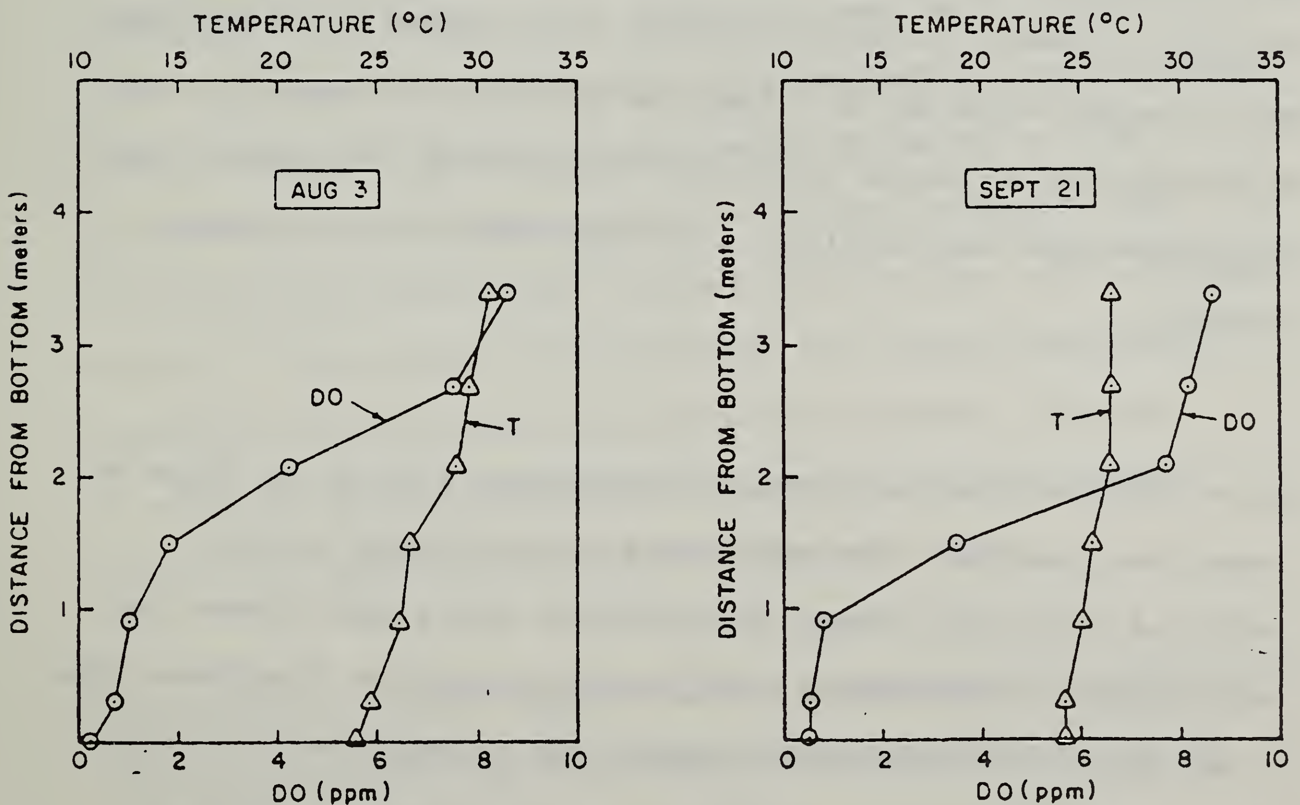

Figure 3. Dissolved oxygen (DO) and temperature (T) versus depth in a reservoir with surface-water release: Site 6, Cheaha Creek Watershed, 1978.

Studies of the dissolved oxygen (DO) and temperature profiles in three reservoirs with surface-water releases and two with cool-water releases revealed important differences. Figures 2 and 3 illustrate how DO and temperature varied with depth for the two types of structures. These figures are for only two dates, but are typical of other profiles established throughout the summer of 1978 for the two types of reservoirs. In all cases the DO levels decreased rapidly with depth throughout the impoundments having surface-water releases. One to two meters below the surface, DO generally dropped below the desired 5.0 mg/L. On the other hand, DO in impoundments with cool-water releases appeared to be well distributed between the surface and the bottom throughout the summer. The DO dropped below 5.0 mg/L only twice in an impoundment with a cool-water release. At Choccolocco Site 7, DO dropped to 4.5 mg/L one meter from the bottom and to 3.2 mg/L at the botton on August 23 and on September 20 it dropped to 4.5 mg/L at the bottom. In general, the DO distributions were excellent in the impoundments with cool-water releases.

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Conclusions

Flood-control impoundments on upland streams will cause shifts in fish populations downstream. The shifts could be either beneficial or detrimental, depending on one's point of view (a case of beauty being in the eye of the beholder).

Redeye bass, a fish species unique to upland streams, is found downstream of impoundments with surface-water releases and cool-water releases. However, the habitat for redeye downstream of structures with cool-water releases may be more favorable than that downstream of ones with surface-water releases.

Impoundments with surface-water releases increase water temperatures of their respective feeder streams more than impoundments with cool-water releases. However, it is uncertain whether the shifts in fish populations due to the impoundments are any more noticeable for structures with surface-water releases than for those with cool-water releases. Good species diversity of fish was evident downstream of structures with cool-water and surface-water releases. Species diversity for macroinvertebrates downstream of a surface-release structure was good and indicated no evidence of stress.

The cool-water releases appeared to have a very beneficial influence on water quality within the impoundments. Excellent dissolved oxygen levels and very little thermal stratification were evident. Impoundments with surface releases, however, were strongly stratified in terms of both dissolved oxygen and water temperature.

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VI APPENDIXES

APPENDIX I

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January 1982

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Charles E. Fogg	Engineering
Thomas H. Dempster	Economics
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David C. Moffitt	West Technical Service Center
John P. Burt	South Technical Service Center

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January 1982

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